ARCANA

OF

SCIENCE AND ART:

OR, AN

ANNUAL REGISTER

OF

USEFUL INVENTIONS AND IMPROVEMENTS, DISCOVERIES AND

NEW FACTS

IN

MECHANICS, CHEMISTRY, NATURAL HISTORY,
AND SOCIAL ECONOMY;

ABRIDGED

FROM THE TRANSACTIONS OF PUBLIC SOCIETIES, AND FROM OTHER
SCIENTIFIC JOURNALS, BRITISH AND FOREIGN,
OF THE PAST YEAR.

WITH SEVERAL ENGRAVINGS.

"Every advance in science has served not to contract the field of inquiry, but to extend it on every side."—SIR ROBERT PEEL'S *Address to the University of Glasgow.*

TENTH YEAR.

LONDON:
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MDCCCXXXVII.

ADVERTISEMENT.

As in former years, it may be both useful and interesting to direct the reader's attention to the principal contents of the present volume, the Tenth of its series.

In the department of *Mechanical and General Science* will be found the present state of the London and Birmingham Railway; the progress of the Thames Tunnel during the past year; notices of Captain Brown's proposed Metallic Light-houses; important facts respecting Steam Communication with India and America; the theory of Traction on Canals; valuable communications on the economy of Steam-boilers; a descriptive paper on the Dublin and Kingstown Railway; the adaptation of Steam to Agriculture; the details of Mr. Rowland Hill's Rotatory Printing Machine; a new Safety Spring for Carriages and Carts; Professor Whewell's illustration of the Science of the Tides; the details of an Iron Suspension Bridge, in India; the theory of Railways, by Dr. Lardner; a popular description of the Greenwich Railway; and a not of Messrs. Arnold and Dent's Balance-springs for Chronometers.

In *Chemistry* and the collateral sciences will be found described the Experiments made at Constantinople with Drummond's Light for Light-houses in the Black Sea; a paper by Dr. T. Thomson on Sulphuric Acid; Dr. Ure's Patent Sugar-pan; M. Bossingault on Bitumens; an experimental paper on Fluorine, by the Messrs. Knox; Professor Faraday on the Magnetic Relation of the Metals; a paper of practical value on the action of Isinglass in clearing Malt Liquor; Dr. Ritchie's Researches in Electricity and Magnetism; Professor Davy on Carburet of Potassium, and a new Gaseous Bi-carburet of Hydrogen; Mrs. Somerville's very interesting experiments on the Chemical Rays of the Solar Spectrum; details of a New Metal called Donium; Berzelius on a New Power which acts in the Formation of Organic Bodies; Dr. Hall's New Thermometer; Dr. Thomas Thomson's Chemical Analysis of Tabasheer; Professor Faraday on Silification; a valuable method of Detecting Arsenic; Mr. Crosse's striking production of Artificial Crystals and Minerals; Dobereiner on several New Combinations of Platinum; Professor Daniell on Voltaic Combinations; Mr. R. W. Fox on Galvanic Changes in the Chemical Character of Metals; M. Couerbe on Thebaia, a New Alkali in Opium; Magnetic Experiments in an Iron Steam-boat; and a paper by Dr. Gregory on Caoutchoucine. This division will be recog-

nised as equal in importance to the corresponding department in either of the volumes which we have hitherto presented to the reader.

Natural History: in *Zoology* are Notices of New Species or rarely described Specimens,—as the Harvest-bug; a New British Fish; the Long-eared Bat; Gordius Aquaticus; Changes in Crabs; Nests of the Wasp; O[illegible]sis Barbara; the Colombia River Sturgeon; the Square-browed Maltha. To these are added papers on the Zoology of Boothia and North America; and Professor Ehrenberg's New Discovery in Palæontology—Tripoli composed wholly of Infusorial Exuviæ. The most striking facts in the Proceedings of the Zoological Society have been selected for this section, as heretofore.

In *Botany* is a paper by Dr. Hope on the Colour of the Leaves and Flowers of Plants; a communication of practical worth, on the Growth of Wheat; notice of Sugar-candy in Flowers, and Boiling Seeds; and a paper by Professor Goppert on Fossil Ferns.

The *Geological* novelties of the year are valuable; as, Mr. Charlesworth's paper on the Vertebrated Animals of the Crag of Norfolk and Suffolk; Mr. Brogniart, on Cobalt at Paris; theory of the Phenomenon of Elevation; Professor Phillips on the Blocks or Boulders in the North of England; M. Combes on Gas in Coal Mines; two undescribed Radiaria; Messrs. Sedgwick and Murchison on the Old Slate Rocks of Devon; Professor Ehrenberg on Fossil Infusoria; a further notice of the Icthyosaurus, by Sir Philip G. Egerton; and a paper descriptive of some recently found Fossils in the London Clay.

Among the *Astronomical and Meteorological* Phenomena will be found notices of the Annular Eclipse of the Sun; and a Meteorological Summary of the year, by Dr. Armstrong.

The most valuable facts elicited at the anniversary of the British Association for the Advancement of Science will be found condensed in each of the preceding divisions.

To these are added Inventions and Discoveries in Rural Economy, Gardening, and Domestic Economy; and the usual Lists, illustrating the progress of Science throughout the year.

To this enumeration we have only to add our thanks for the patronage of the preceding volumes, and our hope that the like may be extended to the present publication.

LONDON, *March* 17, 1837.

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CONTENTS.

ENGRAVINGS.

ARCANA OF SCIENCE,

&c.

MECHANICAL AND USEFUL INVENTIONS.

LONDON AND BIRMINGHAM RAILWAY.

THE following Report of the present state and probable progress of the Works, has been made to the Seventh Half-yearly General Meeting of the Court of Proprietors.

The Directors, since their last Report, have entered into contracts for the works of the stations in London and Birmingham.

At the London end of the line near Camden-town, the company have about thirty-three acres of land, intended as a depot for the buildings, engines, wagons, goods, and various accessories of the carrying department of the railway. At Euston Grove they have a station of about 7 acres for the passenger traffic, and both stations are connected by the extension line. Passenger trains are to be moved on this portion of the railway, by a stationary engine in the Camden depo , and locomotive engines are to be employed on every other part of it. At the Birmingham end of this line, the company have a station of about ten acres, which will serve both for passengers and goods. The arrangement of these stations, and the plans for the necessary buildings and machinery connected with them, have been maturely considered, and the contractors are under penalties that the various works in London shall be completed by June next (with the exception of the façade of the Euston station, for which three months more are allowed), and the works in Birmingham by November next.

The entrance to the London passenger station, opening immediately upon what will necessarily become the grand avenue for travelling between the Metropolis and the Midland and Northern parts of the Kingdom, the directors thought that it should receive some architectural embellishment. They adopted, accordingly, a design of Mr. Hardwick, for a grand but simple portico, which they consider well adapted to the national character of the undertaking. (See the Frontispiece to the present volume.)

The plans and specifications of the buildings at the intermediate stations are in progress, and the whole of this portion of the work will be completed against the opening of the railway.

The greater part of the locomotive engines required to convey the trains of passengers and goods, and of the necessary carriages of all descriptions,

are also contracted for, and will be delivered in succession as they are required to meet the wants of the company.

The directors, in their late reports, expressed an expectation that the first twenty-one miles of the railway from London, would be completed in the spring of 1837. They regret to say, that owing to the late unexampled season, this expectation cannot now be realized before the summer. The engineer reports that the continued bad weather for the last four months, defeated his calculations in a degree which no former experience could have led him to anticipate. In some descriptions of soil, this delay could not have taken place to such an extent as in the London clay, which is exemplified by the progress of the works on other parts of the line, where the material is more favourable; but in the London district the incessant falls of rain have rendered it quite impracticable to proceed with them uninterruptedly. With the excavations and embankments on the Primrose-hill contract, he persevered until the extra expense was such as to induce him to suspend with further operations; a step, in the propriety of which, the directors fully concurred.

The preceding remarks apply especially to the works of the embankments at the Brent, Tring, and the Wolverton Valley; all the minor works, however, have necessarily been affected in a similar way, though in a less degree; but as this delay does not interfere with the contemplated opening of the first twenty-one miles of the railway, it is unnecessary to remark upon them more particularly.

The works of the extension line require but six weeks of fair weather to complete them.

The works of the Primrose-hill contract, which have been continued by the company under the direction of the engineer, are nearly completed, with the exception of the Brent embankment. The Primrose-hill and the Kensal-green tunnels are finished and traversed by the company's engines, and the permanent way is laid through a great part of this contract. Of the embankments on the south side of the Brent-bridge, about 58,000 cubic yards remain unfinished, to complete which, under an ordinary state of the weather, would require three months. That portion of the embankment which is north of the bridge is brought up to it, but not yet raised to the railway level. On the completion of the embankment north of the Brent, the engineer proposes to expedite the formation of the south portion of it by making 6,000 or 8,000 cubic yards of side cutting, thus guarding against further disappointment as far as practicable.

From this point to Watford no work appears to require especial mention, the completion of the Watford tunnel, and the small quantity remaining in the excavations at each end, rendering any detailed remarks on this part of the line unnecessary.

The state of the three succeeding contracts is in general satisfactory; and the engineer reports that, with tolerable weather, and a continuance of the same activity on the part of the contractors that they have hitherto displayed, the works may be completed, and the line opened to Tring, in the autumn. The North-church Tunnel is already finished.

The quantity of water yielded by the cutting, in addition to that which has fallen in rain, together with the argillaceous character of the chalk in the Tring contract, rendered it absolutely necessary to stop proceedings on the embankment, and to confine them to the side-cutting and spoil. It is but justice, however, to the contractor to add, that he persevered in carrying on the embankment, until the engineer reported that it became positively impassable. Notwithstanding this temporary delay, the en-

gineer is of opinion, that the completion of this contract will certainly not be much protracted beyond October next.

By a new appointment of the Wolverton embankment between the two contractors, the works will henceforth proceed satisfactorily.

The Blisworth works being now in possession of the company by agreement with the contractor, all the skill of the engineers, and the pecuniary resources of the company, will be exerted to recover the time lost, as upon these works will depend the opening of the whole railway.

Two lengths of the quicksand portion of the Kilsby tunnel have been completed, and the work there now assumes the ordinary character of tunnelling.

With respect to Blisworth, the engineer in chief reports that arrangements are being made, by which it may be carried on with the utmost expedition. "The rate of progress will depend in a great measure on the quantity of water, and the character and precise extent of the rock which has to be underset by masonry.

Respecting Kilsby, Mr. Stevenson states, that "unless a very unexpected quantity of water should be found, where at present no sign of it exists," we may reckon upon this tunnel being opened, "from end to end, in about seventy weeks."

The line between Birmingham and Rugby will probably be completed before the end of the year; and as Mr. Stevenson states, "that after a careful investigation of the Kilsby and Blisworth contracts, and duly weighing the probable contingencies attendant upon the execution of such works," he is of opinion that "they may be completed in the summer of 1838, and that consequently the whole railway may be opened at that period. The directors have every reason to rely on the fulfilment of the expectations on this head, which in their successive reports have been held out to the proprietors.

The directors took occasion in their last report to congratulate the proprietors on their anticipated accession of traffic from other railways, and amongst the number from the Derby and Birmingham, which was to join the London and Birmingham Railway at Birmingham, and at Stone-bridge. They have since learnt with regret, that a bill is to be brought into Parliament by the Derby and Birmingham Company, for powers to carry their line from Tamworth to Rugby, instead of to Stone-bridge: and that a bill is also to be brought into Parliament by another company, to continue the line from Tamworth to the neighbourhood of Stafford, thus intercepting from the London and Birmingham Railway for the distance between Birmingham and Rugby, a considerable portion of traffic on which this company had every reason to rely. The directors therefore, in compliance with the declared wishes of the proprietors, have made known their intention of opposing what they must look upon as competing lines.

The House of Lords having declared, in the last session of Parliament, that the Cheltenham and Oxford and London and Birmingham Union Railway is not a "competing line," the directors, in the conviction that the proposed communication will be of great importance to the company, and in compliance with the wishes of the proprietors, have decided to give it all the support they can.

The directors were in hopes of seeing an efficient railway communication furnished to the population of Warwick, Leamington, and Kennilworth, by means of a branch communication with the London and Birmingham Railway near Coventry. The intermediate country was surveyed,

and a committee consisting of influential parties in that neighbourhood formed for the purpose of carrying the object into effect. The directors regret, however, to say, that notwithstanding the pains that have been taken to select a line which would be unobjectionable to the landowners through whose property it was to pass, the great majority of them are at present opposed to any practicable line, and the project has therefore been abandoned for the present; but the directors will be glad at any future time, when, as they hope the objections of the landowners may be removed, to give all the support they can to this desirable undertaking.

The directors have made a satisfactory arrangement with the directors of the London and Birmingham and Thames Junction Railway Company, for the conveyance of the traffic of this company upon their line, when required.

By the statement of account [A] now to be laid before the proprietors, it will appear that—

	£.	s.	d.
The Receipts to the 31st December, were	2,380,209	13	9
The Disbursements - - - - -	2,285,321	2	5
	£94,888	11	4

The proprietors, in referring to these accounts, will observe, that the original capital of the company has been expended within 214,679*l.*

The directors have been enabled, as the work approached completion, to prepare estimates [B] which show that the contemplated works for the efficiency of the railway in the carrying department, as well as for the road itself, will require a sum of nearly one million more, and that the total outlay will probably reach four and a half millions.

This additional cost arises—

1st. From additions, alterations, and extras to the original plan of the works.

2nd. From the extension line to Euston-grove.

3rd. From the additional quantity of land (800 a.) and the much higher price the company have been compelled to pay than was at first estimated, a price in some degree extorted by the necessity of obtaining possession at an earlier period than by the provisions of the act of incorporation the company could legally enforce.

4th. From the increased prices which it has been found necessary to give for all the materials composing the permanent way, such as rails, blocks, &c., as well as from the additional weight of the rails, chairs. &c., which experience has shown it to be prudent to use, and from the greater expense of conveying these materials to their destination, than was anticipated.

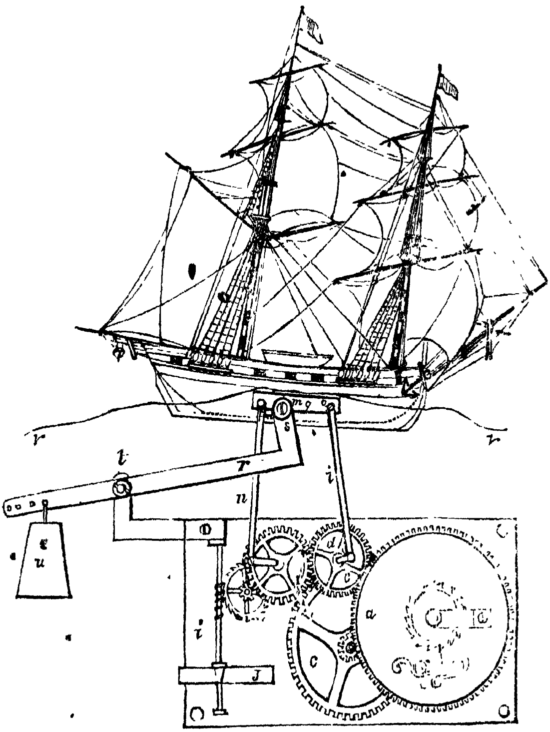
5th. From unforeseen difficulties in the Primrose-hill, the Blisworth, and Kilsby contracts.

6th. From the ample provisions made for the carrying department, and particularly with reference to the traffic to be expected from other railways, for which acts have been obtained since the estimate was made.

On the whole, however, the directors have reason to believe, that by this additional outlay, the railway will prove much more equal to the work it will be called upon to perform in the conveyance of the immense traffic to be expected; and that the cost of the wear and tear, and annual repair, will be correspondingly less, in consequence of the greater strength and solidity given to the works.

AUTOMATIC SHIP AND SEA.

THIS Automaton, has lately been added to the collection in the Gallery of Practical Science, in Adelaide-street, Strand. It is one of the most successful attempts at imitative motion ever accomplished. It is perfectly free from all those interrupted *staccato* effects which generally mar the finest productions in clock-work; and it faithfully exhibits the easy, ever-varying, and ever-blending changes of position and surface, which a steady, stiff breeze will produce on a flowing sea, and a vessel under full sail.



(Automaton Ship and Sea.)

The sympathy, if we may so term it, of the ship with the sea, is admirable; when she seems to overtake a wave, her bow slides

up its side, and is projected into the air; as she rides on its breast, her stern also becomes elevated, and her deck is, for an instant, horizontal; and then, as she leaves it, her bow is depressed, and she sinks bodily down into the succeeding hollow. This last effect is so perfect, that a lady, visiting the gallery, was heard to exclaim to her companion, "Do come away; that subsidence is really so natural, that it brings all my recollections of sea-sickness about me."

To give an idea of the actual size of our vessel, we may state that, from stem to stern, she measures five inches and a half, so that she appears to be not much larger than her portrait in the annexed diagram.

Though the effects are so perfect, yet the mechanism, it will be evident, is very simple. It is concealed in the model from the observer, by a membrane (v), which is attached to the hull, and thence extending to the borders of the machinery-chest, is there fastened. This membrane is very delicate in its texture, and extremely pliant; it is not strained tight, but, on the contrary, left very full; and its surface is painted to represent an agitated sea. In all the elevations and depressions of the vessel, this membrane of course accompanies it; but to the spectator, the motions of the vessel seem to be the effect, and not the cause, of the waves.

In the diagram, one of the containing plates of the machinery is removed to show the connexion of the parts. A spring contained in a barrel (*a*), communicates motion through a train of pinions and wheels (*b*, *c*, *d*), to two wheels (*e*, *f*), which have each the same number of teeth, and are geared together; on the axis of these wheels are cranks (*m*, *k*), which move two shafts (*l*, *n*), attached by centre-pins (*o*, *p*), to the keel (*q*) of the vessel. To this keel is also attached, by a centre-pin (*s*), a lever (*r*), which, resting on a fulcrum (*t*), is continued beyond to any convenient length, and has, near its end, a movable weight attached (*u*). One of the cranked wheels (*f*) is geared by a pinion and wheel (*g*, *h*), and an endless screw (*i*), with a fly (*j*), for regulating the velocity.

Supposing the lever (*r*) to be removed, the cranks and the shafts (*m*, *k*), (*l*, *n*), vertical, and the machinery in action; it will be seen, by examination, that motion would be communicated to the vessel, but that it would be simply vertical, a mere up-and-down movement, and that the deck would always be parallel to the line in which it lay at starting. If we add the lever (*r*), centring it midway between the centre-pins of the shafts (*o*, *p*), a very small, but scarcely a perceptible variation, would be produced; but if now we place its centre-pin (*s*) nearer to the centre-pin (*p*) of one of the shafts, than to that (*o*) of the other, we shall have the motions of the centre-pins so controlled by the radius (*s t*), that they move, both ascending and descending, with different and differing velocities; so that the stem and the stern of the ship will rarely remain for two successive instants in the same level plane.

The invention is French, and patented. The names of T. C. Cailly and Eude, are stamped upon the machinery-case.*

* Magazine of Popular Science, No. 3; established within the past year; and one of the best conducted scientific journals.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Sixth Anniversary was held at Bristol during the week August 22 to 27, inclusive. The most important communications then reported will be found in the several departments of this work; and, in place of enumerating the remaining papers, it may be more useful to report the arrangements made for the next Meeting, to be held at Liverpool, in the month of September, 1837.

The following is a list of the Officers of the Association appointed:—

President, the Earl of Burlington. Vice-Presidents, Dr. Dalton, F.R.S.; Sir P. Egerton, Bart., F.R.S.; Rev. E. Stanley, F.G.S. Treasurer, J. Taylor, F.R.S. General Secretaries, Rev. W. V. Harcourt, F.R.S.; R. I. Murchison, F.R.S. Assistant General Secretary, Prof. Phillips, F.R.S. Secretaries for the Liverpool Meeting, W. C. Henry, M.D., F.R.S.; C. S. Parker, Esq. Treasurer for the Liverpool Meeting, S. Turner, F.R.S.—Members of Council: Members elected, Prof. Christie, F.R.S.; Prof. Daniell, F.R.S.; G. B. Greenough, F.R.S.; H. Hallam; Prof. Henslow; R. Hutton, F.G.S.; Sir W. Rowan Hamilton, F.R.S.; J. W. Lubbock, F.R.S.; Prof. Lindley, F.R.S.; Prof. Owen, F.R.S.; Prof. Powell, F.R.S.; John Robison, Sec. R.S. Edinb.; N. A. Vigors; Rev. W. Whewell, F.R.S.; Wm. Yarrell, F.R.S. Members ex-officio, the Trustees: C. Babbage, F.R.S.; R. I. Murchison, F.R.S.; John Taylor, F.R.S. The Officers named above. Secretaries, E. Turner, M.D., F.R.S.; Rev. James Yates, F.L.S.

The Reports which have been undertaken for the ensuing Meeting are as follow:—

Capt. Sabine. A continuation of his Report on the state of knowledge as to the Phænomena of the Earth's Magnetism.

Mr. Lubbock. The result of the deliberations of a Committee appointed to consider a proposition of that gentleman for the construction of new Empirical Lunar Tables. The Committee consists of the Astronomer Royal, Mr. Baily, Prof. Challis, Sir W. R. Hamilton, Mr. Lubbock, Prof. Rigaud.

Prof. Johnston. On the present state of knowledge of the Chemical and Physical Properties of Dimorphous Bodies in their respective forms.

Mr. J. Taylor. On the Mineral Riches of Great Britain, in relation more particularly to Metalliferous Districts.

Mr. Yarrell. On the state of knowledge of Ichthyology.

Rev. Wm. Taylor. On the various Methods of Printing which have been prepared for the use of the Blind.

The following is a statement of the new and renewed Grants of Money for the advancement of particular branches of science, which have been made by the Association.

Mathematical and Physical Science.

250*l.* For the discussion of Observations of the Tides; at the disposal of J. W. Lubbock, Esq.

150*l.* For the discussion of Observations of the Tides in the port of Bristol; at the disposal of the Rev. W. Whewell.

70*l.* For the Deduction of the Constant of Lunar Nutation; under direction of Sir T. Brisbane, Mr. Baily, and Rev. Dr. Robinson.

30*l.* For Hourly Observations of the Barometer and Wet-bulb Hygrometer; at the disposal of W. S. Harris, Esq.

100*l.* Renewed grant for the establishment of Meteorological Observations and Experiments on Subterranean Temperature; at the disposal of a Committee, consisting of Prof. Forbes, W. S. Harris, Esq., Prof. Powell, Col. Sykes, and Prof. Phillips, who will act as Secretary.

500*l.* Enlarged grant for the procurement of accurate Data to determine the question of the Permanence or Variability of the Relative Level of Land and Sea. The Committee consists of Mr. Baily, Mr. De la Beche, Col. Colby, Mr. Cubitt, Mr. Greenough, Mr. Griffith, Mr. Lubbock, Capt. Portlock, Mr. G. Rennie, Rev. Dr. Robinson, Prof. Sedgwick, Mr. Stevenson, and Rev. Wm. Whewell, who will act as Secretary.

100*l.* For Experimental Investigations on the Form of Waves; at the disposal of John Robison, Esq., and J. S. Russel, Esq.

500*l.* Renewed grant for the Reduction of Observations in the *Hist. Celeste* and in the volumes of the Academie des Sciences for 1789 and 1790; under the direction of the Astronomer Royal, F. Baily, Esq., J. W. Lubbock, Esq., and Rev. Dr. Robinson.

150*l.* For experiments on Vitrification; under the direction of Dr. Faraday, Rev. W. V. Harcourt, and Dr. Turner.

80*l.* Renewed grant for the construction of a rock-salt Lens; under the direction of Sir. D. Brewster.

Chemical and Mineralogical Science.

50*l.* Renewed grant for Researches on the Specific Gravity of Gases; under the direction of Dr. Dalton, and Dr. C. Henry.

30*l.* For Researches on the Quantities of Heat developed in Combustion and other chemical Combinations; at the disposal of Dr. Turner.

15*l.* For Researches on the Composition of Atmospheric Air; at the disposal of Dr. Dalton, and Mr. W. West.

24*l.* 13*l.* For the Publication of Tables of Chemical Constants drawn up by Prof. Johnston.

60*l.* For Researches on the Strength of Iron made with hot and cold blast; at the disposal of Messrs. Fairburn and Hodgkinson.

Geology and Geography.

20*l.* Renewed grant for Experiments on the Quantity of Mud suspended in the water of Rivers; under the direction of Mr. De la Beche, Mr. G. Rennie, and Rev. J. Yates.

30*l.* For special Researches on Subterranean Temperature and Electricity; at the disposal of Mr. R. W. Fox.

50*l.* For Researches into the Nature and Origin of Peat Mosses in Ireland; under the direction of Col. Colby.

Botany.

25*l.* For experimental Researches on the Growth of Plants under glass and excluded from air, according to the plan of Mr. Ward; under the direction of Dr. Dalton, Dr. Daubeny, Rev. James Yates, and Prof. Henslow, who will act as Secretary.

Medical Science.

50*l.* Renewed grant to the Committees appointed to investigate the subject of the Anatomical Relations of the Absorbents and Veins.

50*l.* Renewed grant to the Committees appointed to investigate the Motions and Sounds of the Heart.

25*l.* For Researches into the Chemical Composition of Secreting Organs; under the direction of Dr. Hodgkin, Dr. Roget, Dr. G. O. Rees, and Dr. Turner.

25*l.* For Investigations on the Physiological Influence of Cold on Man and Animals in the Arctic Regions; at the disposal of Mr. King.

25*l.* Renewed grant for the Investigation of the Effects of Poisons on the Animal Economy; under the direction of Dr. Roupell, and Dr. Hodgkin.

25*l.* Renewed grant to the Committee formerly appointed to investigate the Pathology of the Brain and Nervous System. Of this Committee Dr. O'Beirne has been requested to act as Secretary.

25*l.* For Investigations on the Physiology of the Spinal Nerves; under the direction of Mr. S. D. Broughton, Mr. E. Cock, and Dr. Sharpey.

Statistics.

150*l.* For Inquiries into the actual State of Schools in England, considered merely as to numerical analysis; under the direction of Mr. Hallam, Mr. Porter, and Col. Sykes.

Mechanical Science.

50*l.* Renewed grant for an Analysis of the Reports of the Duty of Steam-engines in Cornwall; under the direction of Mr. Cubitt, Mr. J. Rennie, and Mr. John Taylor.

SOCIETY OF ARTS.

THE annual distribution of prizes awarded by the Society took place on Tuesday, June 7, in the Hanover-square Rooms, Sir Edward Codrington in the chair. In the class of polite arts, copies and originals, there was a great advancement apparent; and we would willingly insert a full list of the rewards, and to whom adjudged, had we sufficient space to spare for that purpose; we must, however, confine ourselves to the rewards in the classes of chemistry, manufactures, and mechanics.

1. To Mr. E. Solly, jun., Curzon-street, Mayfair, for an instrument to drive screws on the inside of tubes, the silver Isis medal.

2. To Mr. H. Bellingham, Frederick-place, Hampstead-road, for a carpenter's plane, the silver Isis medal.

3. To Mr. P. Heath, Edward-street, Hampstead-road, for a ruling machine for the use of engravers, the large silver medal.

4. To Mr. J. Meighan, Holland-street, Blackfriars, for his alarum lock, the silver Isis medal and 5*l.*

5. To Mr. H. Wilkinson, Pall-mall, for a maroon lock to prevent depredations in gardens, parks, preserves, &c., the large silver medal.

6. To Mr. Joseph Gretton, Timberfield, near Chesterfield, for his levelling instrument for coal-mines, the large silver medal.

7. To Mr. Cornelius Ward, 36, Great Tichfield-street, for his improvement in kettle-drums, the gold Isis medal.

8. To Mr. H. Soper, gunner of H.M.S. Excellent, for his life-buoy, the silver Isis medal and 5*l.*

9. To Mr. H. G. Pearce, Brunswick-terrace, Blackwall, for his lantern for steam-vessels, the large silver medal.

10. To the same, for his disengaging-claw for a chain cable, the large silver medal.

11. To Mr. J. Kingston, Royal Dockyard, Woolwich, for his nippers for holding metal bars, the large silver medal.

12. To Mr. James King, New South Wales, for his discovery in the colony of Sydney of a white sand for the use of glass-makers, the large silver medal.

13. To Mr. Joseph Glynn, Butterley, near Derby, for his communication on the application of steam power to draining fens, the gold Isis medal.

14. To Mr. J. Newman, 122, Regent-street, for his improved safe-lamp for miners, the large silver medal.

15. To Mr. James Marsh, Royal Arsenal, Woolwich, for his method and apparatus for detecting minute quantities of arsenic, the large gold medal.

Of these, No. 15 promises to be of great value; the apparatus is perfectly simple, and easily used. No. 5 substitutes a rocket for the murderous spring-gun. No. 7 is a pretty improvement on the kettle-drum, and presents great facility in running from flat to sharp.*

ACOUSTIC CHAIR.

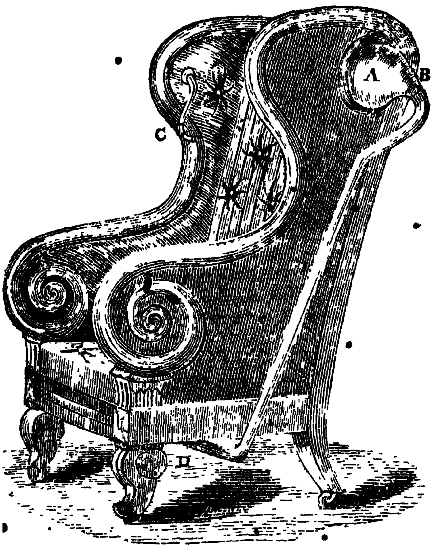
The inventor of this chair is Mr. Curtis, the celebrated aurist, who thus describes the same in the sixth edition of the *Treatise on the Physiology and Pathology of the Ear*, a valuable work,—the result of many years' assiduous devotion and professional experience.

"This chair is intended for the benefit and use of the incurable deaf. A somewhat similar chair was constructed in 1706, by M. Duguet, who likewise invented some acoustic tubes. But one of the great advantages possessed by my chair over his, consists in this, that the person sitting in it hears at the opposite side from that at which he is addressed; thus avoiding the unpleasant and injurious practice of the speaker coming so close as to render his breath offensive, and, at the same time, detrimental to the organ of hearing, by causing a relaxation of the membrane of the tympanum. This is an effect commonly produced by the use of short, flexible tubes, no less than by hearing-trumpets, which latter are as often, perhaps, employed for *speaking* through as for the purpose for which they were designed; and it is a certain fact, that many persons, after having used a trumpet for half an hour, are quite deaf, from the action of the breath impelled against the membrana tympani.

"My acoustic chair is so constructed, that, by means of additional tubes, &c., the person seated in it may hear distinctly, while sitting perfectly at ease, whatever transpires in any apartment from which the pipes are carried to the chair; being an im-

* Literary Gazette, No. 1,012.

proved application of the principles of the speaking-pipes now in general use. This invention is further valuable, and superior to all other similar contrivances, as it requires no trouble or skill in the use of it, and is so perfectly simple in its application, that a child may employ it with as much facility, and as effectually, as an adult. It is, moreover, a very comfortable and elegant piece of furniture.



(Mr. Curtis's Acoustic Chair.)

"This chair is of the size of a large library one, and has a high back, to which are affixed two barrels for sound, so constructed as not to appear unsightly; and at the extremity of each barrel is a perforated plate, which collects sound into a paraboloid vase from any part of the room. The instrument thus contrived gathers sound, and impresses it more sensibly by giving to it a small quantity of air. The convex end of the vase serves to reflect the voice, and renders it more distinct. Further, the air inclosed in the tube being also excited by the voice, communicates its action to the ear, which thus receives a stronger impression from the articulated voice, or indeed from any other sound.

What first induced me to invent this chair, was the fatigue I sometimes experienced in talking to deaf persons.

"By means of sufficient tubes, this chair might be made to convey intelligence from St. James's to the Houses of Lords and Commons, and even from London to the King at Windsor. Marvellous as this may seem, the idea is not a novelty; it is but another confirmation of the saying of Solomon, that there is nothing new under the sun. M. Itard, in his excellent work on the ear, tells us that Aristotle, (who was physician to Alexander the Great,) invented a trumpet for his master, which was capable of conveying orders to his generals at the distance of 100 stadia, equal to rather more than twelve miles. And I may remark, bearing in mind, too, that both Alcmeon and Hippocrates are said to have invented ear-trumpets, that the ancients do not seem to have been so ignorant of acoustics as some in our day have represented them."*

In the engraving, on the near side of the chair, is A, the barrel for sound, with the conductor B attached; D, beneath the chair is the tunnel for the conveyance of the sound. Within the chair is C, the tube to be applied to the ear. This chair is only adapted for hearing: to complete the design, and convey sound from it to a distance, requires another conductor and a mouthpiece.†

IMMENSE BALLOON.

WITHIN the past year, Mr. Green, the aeronaut, has constructed, and made several ascents in, a vast balloon, of which the following are the details:—

The Balloon is 150 ft. in circumference; and the extreme height of the whole, when inflated, and with the car attached, 80 ft; formed of 2,000 yards of silk, imported raw from Italy, in part, dyed crimson by Messrs. Jaques, and manufactured by Messrs. Soper, of Spitalfields. The silk is cut in forty-four gores, alternately crimson and white; their length is 90 ft; they are joined by each overlaying the other, and being doubly stitched; and the seams are overlaid by a cement of such a tenacious nature, that, when once dry the joint becomes the strongest part; this cement

* In addition to the facts previously stated in other parts of this treatise, relating to the knowledge possessed by the ancients in the science of acoustics, there is contained in a MS. found some time since in the Vatican, entitled "Secreta Aristotelis ad Alexandrum Magnum," an account of a circular trumpet, five cubits in diameter, invented by Aristotle for Alexander the Great, and capable of conveying sound twelve miles. The power of this trumpet must, therefore, have been greatly superior to that invented by Sir John Moreland, which only conveyed sound, on the open sea, to the extent of about two miles, even when the wind was favourable.

† Mirror, No. 821.

or varnish filling up the minute space left by the many thousand stitches, which might otherwise allow some escape of gas. The whole of the silk is also coated with a kind of varnish, formed of caoutchouc dissolved in turpentine, and mixed with a certain proportion of boiled oil.

The weight of atmospheric air sufficient to inflate this balloon, would be about 5,346 lbs.; while the silk so inflated would sustain an atmospheric pressure of 20,433,600 lbs.; or 9,122 tons. To inflate the bag with pure hydrogen gas, would require about 364 lbs., at a cost of about 250*l.*; the machine would then have an ascending power of 4,982 lbs.; and allowing 700 lbs. for the weight of silk and apparatus, and 362 lbs. for ballast, it would ascend with 28 persons of the average weight 140 lbs. each. Now, the cost of the 70,000 ft. of coal gas is but 70*l.*; this, indeed, is an extraordinary charge, being at the rate of 20*s.* for every 1,000 ft., although the gas for lighting streets or shops is charged at 9*s.* for every 1,000 ft.

The car of the Balloon is of oblong form, with elliptical ends, somewhat deep, and having a seat around it, the whole being of strong basket-work; and to insure safety, the cords by which the car is attached to the silk bag, are plaited with the wicker. At each end of the car, is the head of a colossal eagle, richly gilt. The draperies covering the car, are of purple and crimson velvet, richly embroidered. The expense of constructing this balloon is stated at 2,100*l.*; the cost of the silk being 700*l.**

THE THAMES TUNNEL.

This stupendous undertaking is now proceeding slowly but steadily towards completion, as may be gathered from the following Report, (abridged,) of the Directors of the Company, to the special assembly of Proprietors, held on the 7th of September, 1836.

The Directors of the Thames Tunnel Company, in compliance with the Resolution passed at the Annual Meeting in March, have convened this special Meeting of the Shareholders to lay before them a Report of the progress of the Works, with a statement of the Expenditure up to Midsummer last; and they have the satisfaction to state, that since the Report they then made, 60 ft. of the Brickwork of the Tunnel have been completed, which added to the quantity previously finished, makes a total of 660 ft. By this addition the Tunnel is now carried beyond the centre of the River, and is steadily approaching the Wapping shore.

As this important Work now occupies a large share of public attention, the Directors take advantage of the opportunity at present afforded them, to place before the Proprietors a few facts connected with its progress and present state, in order to enable them to form correct opinions of the undertaking.

In the first place, it is of great importance to keep in mind this fact viz., that when the Works were stopped in 1828, that stoppage was oc-

* Mirror, No. 796.

casioned by no difficulties of an Engineering nature whatever, but solely on account of the Original Capital of the Subscribers being exhausted. And it is of still greater importance to remember, that at that time, about 599 ft. out of 1,300 ft., which is the extreme length of the horizontal Roadway and the Shaft, were completed for the sum of about 120,000*l* only. The Directors never received of the original subscription more than 182,000*l*., the difference between this and the former sum, viz., 62,000*l*. was, as has been frequently stated to the Proprietors at their Annual Meetings, absorbed by the purchase of Land, the cost of Engines, Machinery, Stores, Buildings, Parliamentary and other expenses, (including the cost of maintaining the Works during the time they were suspended, a period of nearly seven years,) and by the extra Expenditure occasioned by the two irruptions of the River.

The experience hence gained of the nature and cost of the Work, enabled the Engineer to form a practical basis on which to found an Estimate for the execution of the remaining half of the Tunnel, and which has been admitted to be a sound basis for the calculation by successive Administrations, to whom application was made for an advance of Exchequer Bills, in order to enable the Company to proceed with the undertaking.

The Directors, before they proceed to give a particular detail of the advance made towards the completion of the Tunnel since the Annual Meeting in March last, beg to remind the Proprietors, that in their Annual Reports of 1835 and 1836, they endeavoured to guard against an undue expectation of progress in the first year, and they did so from three distinct considerations:—They were assured by the Company's Engineer Mr. Brunel, that to remove the old Shield and to replace it with a new one would be a work of great expense, of slow progress, and of great danger. The expense, however, is one properly chargeable upon the whole work to be done, and must not be considered as exclusively belonging to that which has been recently completed. They were aware also from experience, that when this hazardous work was effected as it was with unexampled skill and presence of mind, that the knowledge of a vast and complicated Machine and the mode of working it could only be acquired slowly, and that hence delay in the rate of progress was incidental to the recommencement of the Works, and was to be expected for some time afterwards. Added to which these difficulties were to be encountered under the deep part of the River, where its bed was known to be most unfavourable to the labours of the Miners and most susceptible of the fluctuating influence of the Tides. Notwithstanding these difficulties, the Tunnel has advanced to the extent already mentioned, and though they have retarded the progress of the work, yet the Miners have acquired both confidence and familiarity in the discharge of their duties and in the management of every part of the Shield, and hence it may be fairly anticipated that when the deep part of the River is passed, and where none of the greater difficulties of the undertaking may make speed of less importance than safety to the men and security to the Works, a quicker rate of progress will become practicable

To enable the Proprietors now to form an opinion of the state of the works, the directors submit the following details under distinct heads, which are in substance the weekly reports of Mr. Brunel to the directors.

The New Shield has fully answered its purpose, and has enabled the work to proceed through some portions of ground in almost a fluid state.

It is greatly superior to the old one. The resistance against which it has to exert its power is computed at about 3,000 tons vertical and lateral pressure, nevertheless it possesses both facility and precision of movement. Some idea may be formed of the extent of the excavation which it enables the miners to carry on through ground of the consistency previously described, and which it preserves until the brick-work is completed, when it is known that the whole area of the ground is equal to 2,000 superficial feet, over the whole of which vents are opened for the infiltration of water both from the river and land-springs, which latter have been found most copious, and sometimes a source of considerable alarm and difficulty. The total area from over which such vents are opened, and through which infiltration takes place, exceeds 75,000 superficial feet.

The Reservoirs and Drains, the completion of which was spoken of in the last report, have been of great value. They have, under the largest influx of water, given facilities to the progress of the miners unknown before. Formerly, forty hand-pumpers, in gangs of twenty each, besides artificers in conjunction with them, were required, who greatly impeded the miners and bricklayers, and who, owing to the adoption of the reservoirs and drains, are now dispensed with.

Rate of Progress. Since the annual meeting, 60 feet of brick-work have been completed; which, added to the 10 feet (always occupied by

the Tunnel approaches the opposite shore, the difficulties of the undertaking will decrease. The thickening of the crust of earth, or the bed of the river, over the head of the miners, will render the more rapid advance of the shield perfectly practicable; and, as the works will then be carried on under shallower water, they will be less influenced by the

course of June last, it will be seen that we have gained considerably in every respect. On many occasions, in June, we were obliged to block up and timber the top boxes, and even to suspend our proceedings until we could approach, as it were, the top polings and probe the ground; but since, and from the auxiliary means which I adopted on the 2nd of July, and made an application of on that day, not one single instance is recorded of the boxes being blocked up, or of ground breaking in; on the contrary, the ground which could not be worked before, and wherein a pricker entered seven feet ahead, was worked with perfect security. We may anticipate that we shall gradually improve in progress." The auxiliary means alluded to in the foregoing report, and which can only be generally described, consist of a system of pinning and isolating a portion of ground, which is then removed without disturbing the contiguous portion from which it is taken, and which has enabled the work of excavation to proceed under the most formidable circumstances. This system, combined with a mode now adopted, of at once conveying away the land-springs and directing their course to the reservoirs, instead of attempting to stop their influx, has enabled the miners to proceed where difficulties have appeared at first almost insuperable.

The Directors regret to add that, owing to the illness of the family of

the late resident engineer, Mr. Beamish, he has been unavoidably obliged to resign his situation, which has deprived Mr. Brunel of the zeal and professional assistance so ably afforded him by Mr. Beamish. The directors, on the recommendation of Mr. Brunel, have made a temporary arrangement with one of their assistant engineers, as it appeared that the duties of the office might be susceptible of a new and better distribution.

In Mr. Brunel the directors continue their unabated confidence; and, in conclusion, whilst they remind the proprietors that the work is one not yet free from both uncertainty and danger, they still desire to reiterate their opinion, that at no very distant period this great undertaking will, in spite of opposing difficulties, be completed, and a communication made between the shores of one of the deepest parts of the river, where, within a small space, the trade and navigation of London may almost be said to be concentrated: and that, in all probability, this communication will be made at less than half the expense of any communication for similar purposes within the range of the metropolis.

(Signed) BENJAMIN HAWES, Chairman.

At the annual meeting of the proprietors, held on March 7, 1837, the chairman, Mr. B. Hawes, stated that, in a short period, the tunnel would be carried below low-water mark, and then much greater progress would be made. The progress made since the resumption of the works was 135 feet. That the public interest remained unabated, it need only be mentioned that in 1836, 37,270 visiters had been down the tunnel, exceeding by 8,000 the number of visiters who had inspected the works in the previous year.

The Report was then read, from which the following are extracts:—

"The directors, since their last report, have the satisfaction to state that a further progress to the extent of 65 feet under the deepest part of the river has been made towards the completion of the tunnel, notwithstanding the natural difficulties which were encountered.

"As it appears to your directors that all the difficulties and delays which have been experienced during the last few months have arisen from the complete saturation of the ground with water, from the long continuance of wet weather; and as, nevertheless, the works have proceeded, and the tunnel has been completed to the extent of 725 ft. 3 in., exclusive of the 10 feet occupied by the shield, they have every reason to believe that the more favourable seasons, which are now before them, and also the extrication of the works from the deep part of the river, towards the Wapping shore, will jointly concur in enabling the engineer to increase the rate of progress before the next meeting, and thereby establish full confidence in completion of the tunnel."

The statement of the accounts of the company for the last half year was read, from which it appeared that a sum of 20,000*l.* has been received from government; that the expense in salaries, works, &c., had been about 2,200*l.*; and the receipts from visiters in the last half year had been 985*l.* 17*s.*

The total amount received in Exchequer bills, from the Exchequer Bill Loan Commissioners, was stated to be 65,000*l.*

SKEW ARCHES.*

On March 4th, Mr. Charles Fox, assistant engineer in the London and Birmingham railway, delivered a lecture on his new mode of constructing the oblique, or, as they are commonly called, "Skew" Bridges, at Watford, and other places. In all bridges at right angles to the stream, the courses of masonry are parallel with the stream; but in oblique bridges the courses are also oblique to the stream, so that one end of the course is much higher up the arch than the other end, and consequently the courses and the stones which compose them have a twisted appearance. If three corners of the cover of a book are held down, and the other corner strained up a little, a very good idea will be obtained of the form of this twist.

Formerly the stones were cut to this twist by no rule, but merely fitted to their particular places. Mr. C. Fox has discovered that this twist is in fact part of a true spiral, *i. e.* in common language, part of the thread of a square threaded screw; and by adopting this simple and beautiful idea, the stones are cut with ease to the required twist, and with such correctness that one stone beds upon any other stone as close if they had flat sides, just as if the thread of a square threaded screw were cut into pieces, the pieces would all bed close upon each other.*

HOW A BALLOON IS CONSTRUCTED.

Balloons are bags of a spherical or spheroidal form, made of gores of silk, coated with a varnish which renders it impervious to air. The best for this purpose is made of caoutchouc. Each of the gores is prolonged into a rectangular strip, and these, when sewed together, form a long cylindric tube. The air having been forced from the balloon by compressing it, this tube is tied to that which is adapted to the inverted barrel, the counterpoise being removed, and the pressure, if necessary, aided by loading the gasometer with weights, the contained gas, with that which is subsequently generated in the barrels, is forced into the balloon until it is completely inflated.

Hydrogen gas having not more than 1·10th of the density of atmospheric air, the joint weight of a large balloon and the gas which it contains, is far less than an equal bulk of atmospheric air; and it will not only rise itself, but will carry with it a considerable additional weight. In order to attach a weight to it, a net-work is formed of cords in such a manner as to embrace the upper half of the inflated balloon, and from its equator, straight cords proceed, to which a car is tied. The balloon must be of such size as not only to carry up the persons who are to mount, with their necessary equipment, but also a considerable quantity of ballast. This is in the form of sand tied up in canvass bags. The object of this combined with a valve in the top of the balloon,

* Repertory of Patent Inventions, No. 28.

is to enable the aeronaut to ascend or descend at pleasure, as long as the ballast and the gas in the balloon are not wholly expended.

This valve is placed on the top of the balloon, and is thus constructed: the gores, instead of meeting in a point, are united upon a ring of whalebone, and thus leave a circular opening; to this a circular shutter of silk, spread upon a similar ring, is adapted by a hinge; two cords proceed from this, over the network, in opposite directions to the car; by one of these the valve can be opened, and by the other, closed.

Then the balloon is released by cutting cords which held it down, the tube which proceeds from its lower point, and is long enough to reach the car, is left open in order that the gas in the balloon may be at liberty to escape as it tends to expand itself, in consequence of its reaching regions in the atmosphere less dense than those nearer the surface of the earth. Although the escape of this gas renders the balloon somewhat lighter, it must finally reach a position where its weight is exactly the same as that of an equal bulk of the surrounding air, and must cease to ascend. A farther height may be attained by throwing out ballast, by opening the bags in which it is contained.

When it is wished to descend, the valve in the top of the balloon is opened until the collapse caused by the escape of the gas renders the balloon heavier than an equal bulk of the surrounding medium, and the force which causes the descent will be an increasing one, as the collapse is increased by the increasing pressure of the denser air. It may therefore be necessary to check it by the discharge of ballast, and by doing this in sufficient quantity, the balloon may be rendered stationary, or caused to ascend again. In the latter case it is no longer necessary to allow the gas to escape by the tube beneath, which is therefore closed.

A balloon has no other capacity of being directed except in ascent and descent. No power has yet been discovered, which can be called into action, of sufficient intensity to propel a balloon through the air, and make it move in a direction contrary to the currents of wind, and which shall be produced by apparatus sufficiently light to be carried up by a balloon.*

NEW LAMP.

A LAMP has been invented by Mr. Rankin, of Edinburgh, which describes a circle of light, about 30 feet in diameter, of the apparent intensity of sun-shine, showing the objects within its sphere as distinctly as those on the table of a camera obscura. The lamp consists of an argand burner, placed in the focus of a large speculum of a peculiar form, by which the light is distributed just on the space where it is required; it being computed that the light on the above space is equal to that of twenty-five or thirty similar burners in common lamps.

* From Professor Renwick's Lectures.

CAPTAIN S. BROWN'S METALLIC LIGHTHOUSES.

It has been proposed to place a lighthouse on the Wolf Rock, near Land's End, a position where it would be exposed to the most violent storms of the Atlantic; and a plan was drawn up for the purpose by Mr. Stevenson, who holds a high rank in this department of engineering; which plan, Mr. Brown thinks, would require fifteen years for its execution, and cost 150,000*l*. Mr. Brown undertakes to erect one of bronze, 90 feet high, which would answer the purpose as well as the stone one of 134 feet, for 15,000*l*., and to complete it in four months. Lighthouses are generally of masonry, the outer stones clamped with iron, and in large blocks, to lessen the number of joints. The one on the Eddystone Rock, near Plymouth, erected by the celebrated Smeaton, is 24 feet in diameter at the base, and 90 feet in height, of which 72 consist of solid masonry. That built by Mr. Stevenson on the Bell Rock, near Arbroath, is 40 feet in diameter at the base, and 110 feet in height, of which 102 consist of solid masonry. The defects of such a structure are obvious. In the first place, it consists of some thousand pieces; and, among as many thousand joints in it, a few faulty ones would be fatal to its strength. Secondly, its great breadth presents an enormous surface to the action of the winds and waves. Mr. Brown estimates, from experiments made by him at the extremity of Brighton Chain Pier in a heavy south west gale, that the waves impinge, on a cylindrical surface one foot high and one foot in diameter, with a force equal to 80 lbs.; to which must be added that of the wind, which, in a violent storm, exerts a pressure of 40 lbs. He computes the collective impetus of the wave on the lower part of Mr. Stevenson's proposed lighthouse for the Wolf Rock, of the surf on the upper part, and of the wind on the whole, to be equal to 100 tons. On the bronze column of 90 feet, which Mr. Brown proposed to substitute for the stone structure, the pressure, calculated in the same way, would be only 6½ tons. The natural height of the wave in a storm is supposed not to exceed 18 or 20 feet; but the *surf*, which is, we suppose, half water and half spray, rises, at times, above the head of the Eddystone column, *hooding* the lantern in a watery coat, and sometimes extinguishing the lights. It unfortunately happens, that adding to the height of the column scarcely produces any greater security to the lights; for, as the breadth must be increased with the elevation, the surf, instead of splitting and passing off by the sides, as it would do upon a smaller column, just mounts so much higher, having a greater surface to resist its onward movement. At the Bell Rock, which is not exposed to such heavy seas as the Eddystone, the surf in a storm mounts to the lights, which are 100 feet above the ordinary level of the sea. At such times, the column is felt to *tremble* when struck by the huge mass of rolling waters; and the keepers, perched like two sea-mews on the top of a beacon-staff, with nothing but the raging elements around them on all sides, feel their situation (as they confess) very forlorn, and naturally think of the sins of their past life.

Mr. Brown's proposed metallic lighthouse is 90 feet high, 14 feet in diameter at the bottom, and 4 feet at the thinnest part. The lower half, called the base, is in four pieces, each piece consisting of a portion of a hollow cone (or paraboloid), wider below than above, and about 10 feet high; the lower piece is sunk 3 feet into the rock, and is 14 feet in diameter at its under margin; the fourth piece is 6 feet in diameter at top. These four pieces fit into each other, the neck of the lower passing into

the socket of the upper, and both being secured by flanges; so that the joints are, in some degree, stronger than the entire part of the shaft. Above these is the smaller part of the shaft, which is in three pieces of nearly the same length, and fitted in the same manner. Above this, the shaft widens out into an inverted cone, which forms one piece, and supports the more important parts. These are, first, the keeper's house, which is 8 feet in diameter, and 7 feet high, with a gallery round it, "for look-out, and walking exercise." Next, the lantern, 9 feet wide and 10 feet high to the cupola, for containing the lights. The house, or sitting-room, is made of two concentric cylinders of sheet copper, 9 inches asunder, to equalize the temperature, and attached to each other by rivets: it is formed into compartments for bookcases, shelves, and lockers, with a recess for the back of the stove. Immediately below the house, in the swell of the shaft, are the sleeping-berths. To complete the description of the column, we shall add, that the upper section of the base contains two tanks, one for oil, and one for fresh water; the next section, above, is for coals and provisions; and the one above that, a general store. Access is obtained from below by the chain ladder reaching down to the sea; and by ladders in the inside, by which the keepers mount to their aerial abode. The whole work, 90 feet high, would cost 16,000*l.* or 17,000*l*, if entirely of bronze; 11,300*l.*, if the base were bronze and the upper part cast iron; or 9,000*l.*, if entirely of cast iron; and it would be erected in four months.

The advantages of this plan of Mr. Brown are the following:— 1. The expense of erecting lighthouses is much diminished, so that six may be erected for the sum now spent on one. 2. The time necessary for building them is contracted from years to months; and the chances of loss of life in the progress of the work are proportionably diminished. 3. The bronze lighthouse, from the slenderness of its shaft, and the smallness of the resisting surface, will not carry the wave and spray half so high as the stone lighthouse; and, with two-thirds of the elevation, it will afford equal protection to the keepers and the lights. 4. From this slenderness, and its diminished height, the strain of the surge and winds upon it, in a storm, will not exceed one-tenth of what a stone structure is exposed to. 5. It has but eight joints from the bottom to the lantern; while the stone lighthouse has thousands; and the bronze joints admit of being made as strong as the entire part of the shaft. 6. That its separate portions, being complete circles, cast solid, each is, *per se*, capable of resisting any lateral impulse of the water whatever, and the column can only be injured by a transverse pressure operating upon its length. 7. That the cohesion of the materials, or the power of the column to resist fracture by a transverse strain, is probably a hundred times as great as in an equal column of stone. 8. That the natural stability of a bronze column, derived from downward pressure, must be considerably greater than that of stone. In addition to this source of strength, the column is to be secured 10 feet into the rock by numerous bolts; so that it cannot be removed, without carrying all that body of rock along with it, which would require a pressure of several hundred tons.

As to the durability of bronze in water, when proper precautions are adopted, two letters are given from Mr. Brande and Mr. Faraday, which remove every reasonable doubt. Both of them think that cast iron might answer sufficiently well for the upper part of the column. Nothing is said about the chances of injury from lightning; but the tower, being

entirely metallic, it would act, we suppose, as a very perfect conductor, and convey the electricity to the earth without injury to the keepers. We should have observed that, in Mr. Brown's opinion, a bronze column could be erected on a sand-bank, by piling, or by a different process, which he describes, and where a stone structure would be impracticable.

The situation of the keepers in one of Mr. Brown's lighthouses is one of the most singular which the multifarious occupations of human life present. The stone tower, though really less secure, has an appearance of solidity, which goes some length to satisfy the imagination; but Mr. Brown's watchmen are suspended in mid-air, on the top of the pillar, whose slenderness, compared with its length, reduces it to the appearance of a small rod. Cooped up in a cage, one half of whose narrow floor projects over the sea, or standing on a gallery which hangs over it completely, they live for months together without exchanging words or thoughts with their fellow mortals. There they pass the dark and stormy nights, with the winds howling, and sea-birds shrieking around them, while the abyss foams and rages below, and the slender stem that bears them above it quivers under their feet when struck by the angry surge, or beaten by the tempest. No situation can be conceived more dismal and monotonous, more beset with terrifying circumstances, or better calculated to impress the mind with a constant feeling of insecurity. Such, however, is the force of habit in reconciling men to outward circumstances, which appal at first sight, and to real and formidable dangers too, that there is never any want of candidates for the most hazardous employments; and no difficulty is, we believe, apprehended in getting sober, considerate persons to commit themselves to these sea-girt aerial cradles; nor any doubt felt, that, after a month's experience, they will sleep secure in them, though lullabied by storms and tempests, the aspect of which, in such a situation, would drive a greenhorn landsman mad.

To understand the importance of lighthouses, it may be proper to state, that the number of British vessels shipwrecked annually is about 550, or *one and a half per day*. The average burden per ship of the mercantile navy is about 110 tons; and, if we value old and new together at half the price of building, or 5*l*. 10*s*. per ton, we have 600*l*. for the value of each, and 330,000*l*. for that of the whole; which may be reduced to 300,000*l*. by deducting the value of sails, masts, and other materials, saved from some of those stranded. If we add an equal sum for the value of the cargoes, the whole loss from shipwrecks will be 600,000*l*. per annum. This statement proceeds on an old estimate from 1793 to 1829; but Mr. Macculloch says, in the Supplement to his Dictionary, that the number of ships lost, or driven on shore, in 1833, was no less than 800. It is probable, then, that the annual loss by shipwreck is not much short of a million sterling. If one-fifth part of this loss could be prevented by additional lighthouses, the saving in money would amount to a million in five years, to say nothing of the still more important saving in human life.*

MARBLE CEMENT.

An important improvement, which has been for several years in progress, is about being introduced to the more general notice

* Bronze is an alloy of copper and tin.

* From the Scotsman Newspaper.

of the public, and, we believe, into extensive use for building purposes. It is a composition or cement, of which the principal ingredient is marble or lime-stone, which, when applied to the inner or outer walls of buildings, presents the appearance of polished marble, of the various hues and qualities which distinguish the beautiful material imitated. What would be thought of a magician who possessed the power of changing the sombre brick and stone walls of the buildings of a city, in one week, into substances resembling the most beautiful Grecian, Italian, Egyptian, or Verd Antique marble, or porphyry, like the rock of Gibraltar! Yet all this may be done by this invention of a humble citizen, of Orange county, in this State. This cement has been sufficiently tested by experiments on buildings, to satisfy practical men of its decided superiority over any other cement, stucco, or other hard finish for walls, hitherto known. A company has been formed in this city to carry on the operations connected with the manufacture of this new cement, and its application to buildings.*

STEAM COMMUNICATION WITH INDIA AND AMERICA.

A VARIETY of communications have been made to the British Association by Dr. Lardner, on the subject of Steam Communication with America and with India—both subjects, at the present moment, of great public interest, and the former especially, at Bristol, where a company has been formed for the express purpose of navigating steam vessels directly, and by a single voyage, between that port and New York; and who are at present building a vessel of 1,200 tons for that purpose. This subject Dr. Lardner introduced in the Section of Mechanics, in a speech of which the following correct report is given in the *Times*:—

The very circumstance of the present and pressing interest which was felt upon this subject of steam communication to distant parts of the world—the fact that already considerable investment of capital had been made in such speculations—these were circumstances which would somewhat embarrass them in arriving at a safe and certain conclusion, because it would be obvious that they would, more or less, engender in the minds of a considerable portion prejudices which would be liable to bias their judgment, unless they used a good deal of self-control, and brought with it the exercise of their own judgment. He would, therefore, beg of every one, and more especially of those who had a direct interest in the inquiry, to dismiss from their minds all previously-formed judgments about it, and more especially upon this question to be guarded against the conclusion of mere theory; for if there was one point in practice, of a commercial nature, which more than another required to be founded on experience, it was this one, of extending steam navigation to voyages of extraordinary length.

Dr. Lardner said he was aware that since the question had arisen in

* New York Railroad Journal, quoted in the Mechanics' Magazine, No. 677.

this city, it had been stated that his own opinion was adverse to it; that impression was totally wrong: but he did feel, that as steps had been taken to try this experiment, great caution should be used in the adoption of the means of carrying it into effect. Almost all depended on a first attempt, for a failure would much retard the ultimate consummation of their wishes. He believed those in the section who knew him would readily acquit him of being forward to question the power of steam. He tendered the most unqualified allegiance to the sovereignty of steam, but he tendered the allegiance of a free and thinking subject to a constitutional monarch. He did not bow before the power of steam as an abject slave, and if he found a failure in the administration of that power, he attributed it entirely to the ministers. It was necessary they should devise some means of determining the locomotive duty of coals. It was a question to which he had devoted a good deal of time, and the only method he had been able to devise had been to determine the consumption of fuel per hour. He had made extensive observations, and he considered you must place 15 lbs. of coal per hour for every horse. Mr. Watt, some time since, established a series of experiments with the view of determining the relative consumption of fuel, and the result was this—that the consumption of fuel under the marine boilers was one-third less than under the land boilers.

A committee of the House of Commons, some time since, had to determine the expediency of opening a long steam communication with India, and much evidence was given. In one case, the opinion was 8 lbs.; in another, 9 lbs.; and another, 11 lbs. They would take nine months. And then came the question of speed. They were all well aware that there had been for some years in operation, a line of steamers by Falmouth and Corfu; they touched at Gibraltar. On an average of fifty-one voyages, the rate at which they made their trips was noted, and the result was seven miles and a quarter per hour. They had, therefore, the conclusion, that the locomotive duty of 9 lbs. of coal was seven miles and a quarter of distance. If, therefore, 9 lbs. gave seven miles and a quarter in distance, one ton would give 1,900 miles for every horse power. Then they must look for average weather; the build of the vessel was such that they had not space to try more than one ton and a quarter of coals for every horse power. Almost all the vessels with which the experiments had been made had the patent paddle-wheels, and they had been worked with the best coals.

The next question was, what modification the vessel must undergo when applied to steam communication with the United States. In the Atlantic there were westerly winds which prevailed almost continually, and were extremely violent, and attended with a great swell of the sea; but it was an astronomical phenomenon which was very well understood. The outward voyage of the great packet-ships was generally estimated at forty days, the homeward voyage at twenty days, so that the entire voyage occupied sixty days. If, then, they assumed that the average of outward and homeward voyage to the United States corresponded with the average weather between Falmouth and Corfu, then they would arrive at this conclusion,—that the outward voyage was worse than the average in the proportion of four to three. If the locomotive duty of coals provided for the voyage between Falmouth and Corfu was 1,900 miles for a ton per horse power, they must deduct from that 33 per cent.: in order to get what the duty would be on the outward voyage to New York, you must take a third from 1,900, and you would have 1,300

miles. By the direct line from Bristol to New York, the distance was 3,500 miles; if you allowed one ton of coals for every 1,300 miles per horse power, the vessel would require to carry two tons and one-third for every horse power in her engine: therefore this vessel must carry nearly three times the whole complement the Admiralty steamers could carry. Let them take a vessel of 1,600 tons, provided with 400 horse power engines; they must take two and a third tons for each horse power, the vessel must have 1,348 tons of coal, and to that add 400 tons, and the vessel must carry a burden of 1,748 tons. He thought it would be a waste of time, to say much more to convince them of the inexpediency of attempting a direct voyage to New York, for in this case 2,080 miles was the largest run a steamer could encounter; at the end of that distance she would require a relay of coals.

The question then became a geographical one, as to the best mode of accomplishing this. There were two ways which might be proposed; one, to make the Azores an intermediate station, and to proceed from thence to New York; the other would be to proceed to some point in Newfoundland, and make that an intermediate station. The distance from Bristol to the Azores was 1,300 miles, and from the Azores to New York 2,400 miles, being 20 per cent. more than the steam limit he had mentioned. There was a point called Sydney, in Cape Breton, where there were coal-mines worked to a profit by Messrs. Rundell and Bridge, but then that was 2,300 miles; but if we took our final departure from some place upon the western coast of Ireland, and there charged the vessel with coals, the distance to Sydney would be only 1,900 miles. The railroad system might be established in Ireland, which would be a benefit in more ways than one. London, and all the southern section of the country, would pour in their produce and population by the railway to Bristol. Dr. Lardner concluded by counselling those who proposed to invest capital in this most interesting enterprise, to keep in mind certain points to which he would direct their attention. 1st. He would advise that the measured tonnage should correspond with the tonnage by displacement. 2nd. To go to an increased expense in using the best coals. 3rd. He would earnestly impress upon them the expediency of adopting the paddle-wheels shown in the section yesterday. 4th. He advised the proportion of one to four on the proper tonnage. 5th. He would impress upon them the expediency of giving more attention in the selection of engineers and stokers; it was a matter of the last importance, and a saving of 30 to 40 per cent. With respect to the boilers, he would recommend copper ones; and he advised that the coal-boxes should be tanked.

A second communication of great interest as it regards this subject, was made by Dr. Lardner, to the Section of Statistics, from which it appeared, that the intercommunication between places which have up to this time been connected by railroads, has, in every case which has been investigated, been increased in the proportion of four to one. Three cases, in which the data have been supplied, gave all of them this result. Before the completion of the railroad, 26 coaches plied between Manchester and Liverpool, and carried, on an average, 400 passengers daily; the railway has been in operation since 1828, and the average number of passengers carried every day by it, has been

more than 1,500. A second case was that of the railroad between Newcastle and Hexham; before its completion, the returns gave a communication of 1,700 persons passing between these by coaches: the first ten months of the railroad gave 7,060, being as before, in the ratio of four to one. The third case is that of the railroad from Dublin to Kingstown, which carries now an average of 3,200 persons daily; whereas, before its establishment, there were carried between the two places an average of only 800 persons daily.

NEW SHIPS' SIGNAL LANTERN.

A MOST admirable invention has recently been brought into use, and is likely to meet with general adoption, intended to prevent those accidents which are the cause of so much loss of property, as well as the annual sacrifice of a number of valuable lives. It consists of a ship's lantern, of copper, strongly and efficiently constructed, and possessing the means of being regulated so as to show a light of different colour, according to the tack upon which the vessel bearing it may be sailing, or the position in which she lies. A set of instructions accompanies each lantern, by which the master is informed what light he is to show on each change of tack and position, and thus a mutual understanding is attained among navigators as to the meaning of the signals exhibited. The change of colours are effected by the following simple contrivance:—The lantern contains an interior case, capable of being turned round, and having windows of glass of several colours. The lamp of the lantern has a strong reflector and powerful bull's eye, or magnifier, to project the light, opposite which, in the outer case, is an aperture. By turning round the interior case, each coloured glass window is brought in front of the bull's eye, and thus a light of the colour required is projected.†

EMBOSSING ON WOOD.

A NEW and ingenious method of embossing on wood has been invented by Mr. J. Straker. It may be used either by itself, or in aid of carving, and depends on the fact, that if a depression be made by a blunt instrument on the surface of wood, such depressed part will again rise to its original level by subsequent immersion in water. The wood to be ornamented having first been worked to its proposed shape, is in a state to receive the drawing of the pattern: this being put in, a blunt steel tool, or burnisher, or die, is to be applied successively to all those parts of the pattern intended to be in relief, and at the same time is to be driven very cautiously, without breaking the grain of the

* Magazine of Popular Science, No. 8.

† Hull Packet, quoted in the Mechanics' Magazine, No. 666.

wood, till the depth of the depression is equal to the subsequent prominence of the figures. The ground is then to be reduced by planing or filing to the level of the depressed part; after which the piece of wood being placed in water, either hot or cold, the parts previously depressed will rise to their former height, and will thus form an embossed pattern, which may be finished by the usual operation of carving.*

TRACTION ON CANALS.

AMONG the communications which have been made to the British Association, are those of Mr. Russel, of Edinburgh, on the subject of Traction on Canals; and, as connected with this subject, that of a certain wave which is, it appears, produced in a canal when a body is put in motion, analogous to that which might be produced if we suppose a mass of water suddenly to be let in at the extremity of the canal. This wave, Mr. Russel stated, to move along the canal with an *uniform* velocity, between which and the depth of the canal there was this remarkable relation, that the velocity was exactly that which a heavy body would acquire in falling *freely* through a space equal to one-half the depth of the canal. Proceeding continually with this same velocity, but diminishing continually in height, the same wave had been followed by Mr. Russel, and distinctly seen for a mile and a half; and it had been perceived in another case to exist at a distance of three miles from the place where it originated. Since the velocity of the wave depends upon the depth of the canal, it will be affected by any occasional shallowness, and will be less near the sides than at the centre; and, moreover, canals differing from one another in depth, will have different corresponding velocities of the waves which are propagated through them. Now, upon this depends a most important condition of the traction of barges upon the canal at high velocities.

The received law of the resistance of fluids, is one by which it is made to vary as the square of the velocity; so that a boat drawn through a fluid with twice the velocity of another, would require four times the traction; drawn with three times the velocity, it would require nine times the traction, and so on. And if this law had no modification in practice, to draw a boat at nine miles an hour would require nine times the traction, (nine times the actual pull of the horse, to say nothing of the rate at which he must go,) that it would to draw it at the ordinary rate of three miles an hour. Thus, the possibility of impelling canal boats to any useful purpose with any but very low velocities was never thought of. Boats are, nevertheless, now drawn commonly on the Forth and Clyde canal, at the rate of nine or ten, or, we believe, in some cases, at twelve miles an hour, and with

* Mechanics' Magazine, No. 681.

less traction than they can be drawn at four, five, or six miles an hour. The wave observed by Mr. Russel, and the uniformity of its motion, connects itself with this fact. The boat, when put in motion, sends its wave before it, whose motion has nothing whatever to do with that of the boat, but depends only upon the depth of the canal. In the Forth and Clyde canal, its velocity is eight miles an hour. Whilst the boat moves then at less than this velocity, it is behind the wave; and so long the resistance is continually greater as the velocity is greater, and according to the received law of the squares.

At seven miles and a half, or eight miles and a half an hour, the boat overtakes the wave, and is lifted upon it, and then the traction, instead of being less than it was at seven or seven miles and a half, became suddenly greater. It was in one instance observed to be, at seven and a half miles an hour, 330 lbs. by the dynamometer; while at eight and a half miles, instead of further increasing, it fell to 236 lbs. The complete explanation of this fact remains, perhaps, to be given; the fact itself is unquestionable. Its application to the navigation of canals is evident.

Every canal has, according to its depth, a certain velocity of wave, on which depends the rate at which a fast boat may best be impelled.*

MANUFACTURE AND TEMPERING OF SWORD-BLADES IN THE PROVINCE OF CUTCH.

From information communicated to Capt. Bagnold, R.M., by his brother, Lieut.-Col. Bagnold, late President of the Regency in Cutch.

THESE swords are celebrated throughout India for their peculiar strength and edge, and are thus made:—An inch bar of fine Swedish or English steel is forged out into plates seven inches long, one inch broad, and one-sixth of an inch thick. Similar bars of fine, soft iron are prepared in the same manner. These are smeared with a paste of borax dissolved in water, and laid in piles of twelve—nine of steel to three of iron, or three to one, alternately: each pile is wrapped round with rag, thickly plastered with mud made of a loamy earth; then heated, welded, and drawn out to a bar one inch and one-eighth broad, and one-third of an inch thick: this is bent zig-zag three or four times: is again welded and drawn out to half an inch thick; and, during the heat, borax is frequently dropped on the metal while in the fire. Two or three bars are next welded into one, and, when about twelve or fourteen inches long, it is bent into the form of a loop or staple: in the middle of this a piece of fine-grained file is inserted, of the same width, and nearly as thick: all is then welded together, and the blade is formed.

Tempering.—An earthen pot, twelve inches wide and six

* Magazine of Popular Science, No. 8.

deep, is notched on the edges (the notches being opposite each other,) with a file, about a quarter of an inch deep, and is then filled nearly up to the notches with water, and oil is then poured on the surface. The blade being heated equally to a light red, is removed from the fire, and the point, entered into the notch on one edge, is passed to the opposite one, keeping the edge from a quarter to half an inch in the oil: it is drawn backwards and forwards rather slowly till the hissing ceases, and the rest of the blade above the fluid has become black; a jug of water without oil is then poured along the blade from heel to point. In order to take out the warp produced by tempering, the blade, when nearly cold, is passed over the fire three or four times; then, being brought to the anvil, is set straight by striking it regularly, but moderately, with a hammer; by this means a Damascus-curved blade may be brought nearly straight. Blades made this way, in my brother's presence, when he was President of the Regency in Cutch, were proved, previous to grinding, by striking at stones, ramrods, musket-barrels, and even wheel-tires, without injury to the edge.*

SAFETY-STOPPER FOR STEAM-BOILERS.

EXPLOSIONS of steam-boilers are frequently the effect of an accumulation of sediment within them. This forms a crust on the interior surface, particularly on the bottom, and being a bad conductor of heat, insulates the metal from the water. It is, therefore, extremely favourable to the former acquiring a high and injurious temperature. When this has happened, the difference of dilatation, which sometimes occurs, destroys the adhesion of the sediment, and exposes the incandescent metal to the water. The instantaneous production of steam, which is the consequence of the contact, is often so enormous, that the boiler, unable to withstand the sudden increase of pressure, explodes with more or less violence. To this peculiar case of danger, no one had, up to a very recent period, been very successful in applying a means either of remedy or of prevention. To use distilled or filtered water, to invite the deposit to subside in parts of the boiler not exposed to the fire, and to prevent accumulation, by frequently cleaning out the boiler, were the principal means used. That these have been very inadequate, and that a remedy for the evil, or a prevention of its occurrence, had been long desired, every one at all acquainted with the causes of destruction of steam-boilers is well aware. Water which, on evaporating, leaves no sediment, cannot be obtained in a vast majority of instances in which steam-boilers are used, and the labour and inconvenience which the frequent removal of the deposit requires, often causes

* Transactions of the Society of Arts, quoted in the Mechanics' Magazine, No. 665.

this necessary operation to be deferred far beyond the time that it ought to be done, either for the preservation of the boiler, or the safety of those near it. With this view of the case, and with the recollection of the length of time this particular cause of mischief had baffled the ingenuity of the most successful improvers of the steam-boiler, we can easily feel how eagerly would be received an invention which should faithfully give an indication of this peculiar danger whenever it may be approaching, and which should, if this indication be neglected, avert the danger, by suspending, in proper time, the action of the immediate agent.

Such an invention has been recently accomplished by M. Galy-Cazalat.* It has been patented both in France and in England; and after the usual severe examination of La Société d'Encouragement of Paris has been declared worthy of their large gold medal.

The simple and ingenious apparatus, by which M. G.-C. succeeds in rendering this essential service to the safe application of steam-power, is the following:—it should, however, be premised that the invention is not intended to be substituted for the present safety and escape-valves, but to be used in addition to them. A small tube is passed through the boiler and its top and bottom, directly over the part where the fire strikes the latter most forcibly. The upper extremity of the tube projects from the boiler, and is terminated by a transferring-cock.† The lower extremity is rivetted to the boiler-bottom, and its aperture is slightly contracted in its diameter. In the passage of the tube through the boiler, a communication is made between them by a few holes. These are pierced in the tube, and so as to be as high as possible above the regular water surface level.

The aperture of the lower extremity of the tube is closed by a means which deserves attention. A stopper, which may be either a plug or a ball, of fusible metal, is deposited in the transferring-cock, and by the half turn of the handle conveyed into the tube: as soon as it has dropped from the cock, it is exposed to the current of steam rushing through the perforations in the tube and is driven along like the ball in an air-gun. At the end it is arrested by the contracted diameter of the tube, and is so powerfully held there, that it hermetically seals the aperture. This stopper, so applied, becomes an integrant part of the boiler, and from its position is, like it, exposed to the direct action of the fire; but there is this important peculiarity with regard to the

* Professeur des Mathématiques-Physiques at the Royal College of Versailles.

† This cock is similar to the greasing-cock of a steam-engine—its plug is not perforated, but has a chamber only, this receives the article to be transferred; on turning the plug half round, the chamber is exposed to the other part of the tube, and the article drops into it. The use of the cock is to keep the tube closed during the transfer.

stopper—it never can be, on its upper side, in contact with any thing but steam. Now that of the boiler-bottom is always intended to be in contact with water, and may be separated from it by sediment.

If we suppose a boiler-bottom, guarded by a safety-stopper, to be liable to become dangerously heated by either of the sets of circumstances which are the sole causes of this species of mischief,* the stopper will melt before the danger becomes serious, the tube will be uncorked, and steam will issue precisely at the point it can be most effective, *i.e.* directly upon the fire; the latter will therefore be instantly damped, and the usual danger as instantly averted. This alone is a most valuable property in the invention, and sufficient to recommend it to general adoption; but it has this additional advantage in practice; viz., that it operates without stopping the engine; that as it damps, not extinguishes, the fire, the supply of steam is moderated, and never entirely suspended, and that another stopper can, by means of the transferring-cock, be conveyed into the tube, and the aperture again hermetically sealed in a very few seconds after the fusion of its predecessor.

M. G.-C. extends the application of this principle to the sides, as well as the bottoms, of boilers, in order to prevent the mischief which results from a depression of the water-surface below the level of the flues. In this case the tube passes obliquely from the top of the boiler through it, and terminates in the side to be protected, and the plug-form of the stopper is changed to that of a ball. Should the water-depression take place, and the boiler-side become, in the absence of water, too much heated by the action of the fire, the ball will melt like the plug in the first instance, and the same desirable consequences will follow.

M. G.-C. also suggests, that the injection pipe of the water-supply should extend further into the boiler than usual, and be carried quite round its sides at the greatest convenient height, and that this prolongation should deliver the water through a large number of small holes, so distributed that they should bathe the whole interior surface of the sides. This would be another means of preserving them at all times from injurious increases of temperature, even when the water in the boiler might be the lowest possible.†

HUNTER'S STONE-PLANING MACHINE.

At a late meeting of the Institution of Civil Engineers, the merits of the patent stone-planing machine formed the subject of conversation. Drawings of the machine, and several specimens of the planed stone, being laid upon the table, Mr. Lindsay Car-

* These are—total absence of water in the boiler, from deficiences of supply, &c., and—insulation of the bottom by sediment.

† Magazine of Popular Science, No. 6.

negie explained its mode of operation, and made several statements as to its actual performances. The principal objection to all former machines for a similar purpose—the immense friction and consequent destruction of tools—seems to have been completely obviated in this instance, as Mr. Carnegie stated that "the wear of tools was so trifling, that it was scarcely worth nothing in calculating the expense of working the machine:" this arose, he said, from the peculiar mode of working,—the tool not coming in contact with the stone more than four times in a foot, and thus, not being heated by friction, it does not lose its original tempering.

At a subsequent meeting of the Institution, the subject was resumed, when Mr. Cubitt, the eminent engineer, said he had occasion to be in Scotland a short time since, and having heard much of Mr. Lindsay Carnegie's machine and its operations, he sent three slabs of stone—two slabs of very hard slate stone, and one slab of hard Yorkshire—that he might see them planed in order to speak to its effect. These slabs were each three feet long, and fourteen inches wide. They were put upon the planing machine, and the roughing tool passed over each of them in three minutes, and the smoothing tool in four minutes; it planed them very well. His opinion of Mr. Lindsay Carnegie's machine was decidedly favourable. He thought it not particularly useful in dressing stone for builing purposes, but more adapted for slates, pavements, and landings, which it planes admirably. He thought all slab work might be planed by it at a farthing, or from that to a halfpenny, per square foot.

The immense saving which will be effected by the use of this machine in London may be imagined from a statement made by a member, that he had just before been charged *ninepence* per foot for smoothing a stone seven feet by four and a half. According to Mr. Cubitt's statement, the maximum cost by the machine would have been *one halfpenny!*

We understand that a working model of this machine has been placed in the Adelaide Gallery for the purpose of exemplifying its mode of working—which it does as well as can be expected, when it is considered that the moving part of the model does not weigh above a hundred weight, while the same part in the machine itself weighs about two tons. From this model, however, any person interested may fully understand the whole *modus operandi* of this important invention.*

VELOCITY OF WATER-WHEELS IN THE NIGHT.

Popular notions must always be a subject of curiosity and interest to philosophical inquirers, whether these notions are founded on observation, or confounded with superstition; and

* Mechanics' Magazine, No. 665.

we are not aware that any popular notion is more extensively diffused among millers (though many of them may not believe in it,) than that which ascribes a greater velocity in the night than in the day to a water-wheel under the same head. Why there should be any difference, none of the believers in this doctrine have ever been able satisfactorily to explain. To argue against it has been futile, because early prejudice was stronger than the powers of reason; and, therefore, no other way remained that could prove effectual, but to bring it to the test of experiment. For this labour we are indebted to Professor Cleaveland. His statement, which follows, is contained in a letter to Professor Silliman, and published in the American Journal of Science and the Arts:—"In a former letter I mentioned the opinion existing in this part of the country, that saw-mills move faster during the night than the day. The explanation usually given by the workmen is, that the air becomes heavier after sunset. I selected a fine day in August, and requested that all the mill-gates might remain stationary for twelve hours. At two o'clock P.M. I suspended a barometer in the mill; the pressure of the atmosphere was equal to 29·19 inches; the temperature of the water just before it passed the mill-gate was 72° Fahr. The log was then detached from the saw, and the number of revolutions of the wheel, being repeatedly counted by different persons, was 96 in a minute. At midnight I again visited the same mill. The barometer stood at 30·26 inches, the pressure of the atmosphere having increased seven-hundredths of an inch. The temperature of the water was 72°, the same as at the preceding observation, although it had been a little higher during the afternoon. The log being detached as before, the wheel was found to revolve precisely 96 times in a minute, showing the same velocity as at the preceding noon. The depth of the water was the same during both experiments. The workmen were satisfied that the result of the experiment was correct, but still they seemed to believe that it would be different in a cloudy night."*

SELF-REGULATING APPARATUS FOR THE SUPPLY OF STEAM BOILERS.

As the most frequent cause of the explosion of steam boilers arises from the depression of the water surface below a certain level, it is evident that the constant maintenance of this surface at a proper height, is an object of the highest importance. It appears, from causes into which we shall not now inquire, that much more attention has been paid to this essential appendage of a safe boiler in the United States and in France, than in this country. We select two instances to which publicity has re-

* American Railroad Journal, quoted in the Mechanics' Magazine, No. 671.

cently been given, in the latter kingdom, by the Société d'Encouragement. One of these is of universal application, and possesses that extreme simplicity which characterizes the results of refined invention. M. Galy-Cazalat, whose safety-stopper has been described in a preceding page, is also the author of this apparatus. To the chamber of a feeding-pump (which has a power more than sufficient to supply the greatest evaporation, leakage, &c., of the boiler to which it is applied), M. G.-C. attaches a very small tube, this he leads into the boiler, and establishes a second connexion between them, the first being the usual one,—that of the injection-pipe. This small tube rises in the boiler to the required water surface level, and there expands into a cup-shaped termination. In this lies a hollow metallic sphere, light enough to float in water; and though allowed a certain play, yet is prevented by a bridle from escaping, and thus acts as a valve. This is the whole apparatus; its action is as follows:—When the supply happens to be larger than the evaporation, &c., takes off, the water surface naturally rises in the boiler; this rising lifts the spherical valve out of its seat, and permits a small quantity of the hot water to pass through the tube into the pump, the next exhausting stroke of which, by producing a vacuum, changes the hot water into a volume of steam, which, filling the pump, prevents the rise of water, and checks the supply. The succeeding strokes of the pump continue ineffective by the same means: they merely create and compress steam, until the water in the boiler is so much evaporated, that its surface descends low enough to reseat the spherical valve, and cut off the connexion between the boiler and the pump: this done, no more hot water can descend, the steam in the pump is condensed, and the latter recommences the water supply; a little time may be necessary in the warming and cooling of the pump before its full operation can, in each change, be attained, but the range of water surface in the boiler, through which it may safely travel, is always sufficiently ample to permit this. To facilitate the cooling, the piston of the pump is made hollow, so that the atmosphere may have access to it. As, in order to insure the buoyancy of the metallic sphere, it must be made very thin, and therefore unequal to sustain great pressure when occurring on one side only, M. G.-C., to prevent its being crushed by the steam, incloses a little water within it. This is, of course, raised into steam of the same elasticity of that which surrounds it, and exactly balancing the external pressure, preserves the sphere from a change of form.

The other apparatus referred to has been adopted by the proprietor of a large establishment in France, and can be used in stationary steam-boilers only. The apparatus consists in a receiver and two stop-cocks, put in action by a counter-weight, which is raised occasionally by an hydraulic lever. A correct idea of the arrangement may be formed by imagining a cylinder

to be attached to one end of the beam of a balance, and a weight at the other.

The receiver, by its position with regard to the steam-boiler and a reservoir of water, can be suddenly filled with either water or steam. Its weight is thus varied, and will become either greater or less than the counter weight. When filled with water it is greater, and, of course, the beam declines on the side of the receiver. When this is replaced by steam, the counter weight is heavier. This then descends, and raises the receiver. The axis of the beam is in connexion with the stop-cocks, which, in the several positions resulting from the movement of the beam, open communications alternately with the reservoir and with the boiler.

When the receiver has obtained its dose from the reservoir, it descends by its superior weight; a stop-cock is opened, and, if the water level be low, the contents of the receiver pass into the boiler; and the former losing weight by the exchange of water for steam, is lifted by the counter weight to the reservoir, and, receiving a further supply, again descends. If the water level be sufficiently high, though the communication by the stop-cock be made, yet no water passes, and the receiver remains stationary until the water level descends below the assigned point. This last effect is owing to the orifice of communication being below the desired water level; and of course not being open unless the water surface has descended below it.

This mode of feeding a boiler has been in actual operation, in the establishment in which it is erected, for several years, and its success has completely demonstrated the practicability and the value of the design.*

MACHINE FOR SPREADING INDIA-RUBBER UPON CLOTH.

Patented by William Atkinson, of Lowell, Massachusetts.

The cloth, says the patentee in his specification, to be coated with India-rubber, is to be made into an endless web. This web is passed around cylinders which are made to revolve, and the dissolved caoutchouc or India-rubber, is spread upon the endless web by the aid of a third cylinder, placed parallel to, and nearly in contact with, one of the cylinders around which the enless web passes.

I make a frame of wood; into the lower parts of this frame, uprights are mortised, which serve to support a rail on each side, leaving, however, the sills sufficiently clear within the uprights to form a railway upon which the rollers of a carriage may traverse back and forth.

Upon suitable supports, at one end of this frame, there are placed two cylinders of metal, of cast iron, of one foot in diame-

* Magazine of Popular Science, No. 6.

ter, and two feet nine inches long. The axes of these cylinders are parallel to each other; around the inner cylinder the web to be coated passes; and the outer cylinder is made adjustable by means of screws, or otherwise, so that it may be brought into contact with, or removed to any required distance from, the web, or cloth. These cylinders are geared together by means of toothed wheels upon their shafts.

The second, or carriage cylinder, (also of metal,) around which the endless web passes, is supported upon a carriage, furnished with wheels, or rollers, which run upon the lower rails or sills. When used as a drying cylinder, it should be three feet. A windlass is placed at the back end of the frame, from which ropes pass to the cylinder carriage, serving, by means of a winch, to draw the carriage, so as to render the cloth taut. Steam is to be admitted into the cylinder through a hollow gudgeon.

In order to apply the solution to the cloth, &c., and to confine it to the proper width, we fit two cheeks, or pieces of wood, or metal, so as to rest upon the two contiguous rollers, one at or near each of their ends, and these, when in their places, convert the rollers into a trough, or hopper, for containing the solution. The distance of these pieces from each other is regulated by attaching them together by means of a frame, or rod, at their upper sides, so that they may slide, and be affixed in their places by thumb screws, or otherwise.

To prevent the cloth adhering to the outer roller, among other methods, wet sponges or brushes may be laid along it.*

JONES'S SPARK-ARRESTER.

THE Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, to whom was referred for examination an apparatus for stopping the sparks from the flues of locomotive engines, invented by Mr. Alfred C. Jones, of Portsmouth, Virginia, report:—

That it has for some time been considered a desideratum to devise a plan by which the sparks escaping from the chimney, or smoke-pipe, of a locomotive engine, may be arrested, so as to insure both the comfort of passengers and the safety of goods transported on railroads. The rapid extension of this mode of conveyance is every day rendering this object of increased importance. Judging from the certificates of engineers and others, exhibited by Mr. Jones, it may be inferred that he has been more successful in relation to it than preceding inventors.

The principal peculiarities of Mr. Jones's invention are the following:—

1. A projection, and funnel-shaped opening, in the front part

* Mechanics' Magazine, No. 672.

of the wire gauze which surmounts the smoke-pipe. This opening is for the purpose of admitting the external air to mix with the escaping smoke and steam, and is supposed to have the double effect of cooling and condensing the smoke and steam, so that it will not burn and destroy the wire gauze, and of producing a horizontal or backward current of air, which throws the sparks into the receptacle hereafter described.

2. A peculiar shape in the wire gauze cap, extending a considerable distance backward, over or beyond the back of the top of the smoke-pipe, which affords a space for the sparks to be thrown down into the receptacle hereafter described, the shape of the back part of the cap, or wire gauze, being such that the sparks do not strike it perpendicularly, but obliquely to its surface, and thus are thrown down instead of passing through the apertures.

3. A receptacle for sparks, back of the top of the smoke-pipe, and under the back part of the gauze cap, at the lower part of which receptacle is a pipe, extending downward into the smoke-chamber at the end of the boiler, and below the part immediately connected with the boiler. Through this pipe the sparks pass, and fall into the bottom of the smoke-chamber. It is supposed by Mr. Jones, that the impetus of the steam, escaping from the engine through the smoke-pipe, produces a partial vacuum in the bottom of the smoke-chamber, and causes a portion of air to rush down the said pipe, which makes the sparks more readily descend to a place where they are beyond the influence of the escaping current of smoke and steam, there to be consumed.

4. The gauze cap is made with hinge joints, so as to be thrown over backward when the engine is not under way. This contrivance serves the double purpose of preventing the gauze from being clogged with lamp-black, by the thick smoke escaping before the starting of the engine; and of facilitating the cleansing of the gauze, by a brush applied to its inner surface, where the smoke and lamp-black condenses.

It is the opinion of the Committee, that each of the foregoing features is productive of advantage. Hence, they are of opinion, that Mr. Jones's apparatus is among the best that has been devised; an opinion which is confirmed by the respectable testimony which has been adduced.

There is a suitable apparatus for arresting the sparks when the engine is going backward, which it is deemed unnecessary here to describe.*

RAISING THE STATUE OF NAPOLEON.

At a meeting of the Institute of British Architects, held on the 3rd of June, Mr. T. L. Donaldson, Honorary Secretary, explained

* From the Journal of the Franklin Institute, quoted in the Mechanics' Magazine, No. 671.

the means lately employed for placing the statue of Napoleon upon the Colonne Vendôme, Paris. This operation was one of considerable difficulty. It is true that, as a statue had previously been placed on this column, and had been removed, M. Lepère, the architect charged with the task of erecting the present statue, had precedents to resort to; but, unfortunately, they were such as were of no use to him. When the first statue was placed in its elevated situation, the workmen availed themselves of the scaffolding already fixed firmly in the ground for erecting the column, and, of course, found scarcely any difficulty; and the apparatus which was used for taking down the statue was inapplicable to the raising another in its place. M. Lepère was therefore obliged to contrive a plan for himself, which he adopted with great success, and which has the rare merit of being extremely simple, at the same time that it displays an admirable combination of theoretical knowledge with practical experience.

This plan consisted of a scaffolding, on which was placed the crab destined to raise the statue, and which had for its basis the front wall of the column, and for its point of resistance the whole weight of the cupola, which was nearly 27,000 kilogrammes. The weight of the statue, crab, cable, &c., was about [illegible],000 kilogrammes; so that an immense power was given to the long arm of the lever. The details could not be understood without cuts.

The statue, which was modelled by M. Seure, sculptor, was cast at Roule, by M. Crozatier. Its height is eleven feet French (about twelve feet English,) from the top of the hat to the plinth, and the plinth is nine inches, French, more. The statue is fixed on the column by strong iron pins, which are soldered deeply into bronzes, placed for that purpose on the capital of the column.*

REMARKS ON THE DUBLIN AND KINGSTOWN RAILWAY, INTENDED AS A SUPPLEMENT TO A FORMER PAPER ON THE LIVERPOOL AND MANCHESTER RAILWAY.†

By Mr. David Stevenson, Edinburgh.

SINCE my paper on the Liverpool and Manchester Railway was laid before the Society of Arts, in February, 1835, I have, in the course of my professional pursuits, visited most of the public railways of the United Kingdom, and, in connexion with this subject, I also paid a visit to some of the great iron-works in Wales.

The application of tram-roads and wooden railways to the conveyance of coal and other mineral products, was introduced in the neighbourhood of Newcastle so long ago as the sixteenth

* Architectural Magazine for July, quoted in the Mechanics' Magazine, No. 673.

† See Arcana of Science and Art for 1836, p. 25—31.

century; and this species of road, although it possesses many disadvantages, is still in use in some of the old mining districts, both of England and Scotland.

At Colebrook Dale Iron-Works in Shropshire, Mr. Reynolds, the proprietor of these works, in the year 1767, first substituted the metallic plate railway for the wooden road, a most important era in the history of what has appropriately been termed the "British Roadway." Emboldened by the success which attended the introduction of the cast-iron railway, it was the same person who, in the year 1777, erected over the river Severn the first cast-iron bridge constructed in this country.

A great improvement was undoubtedly effected in the construction of railways, by the introduction of the cast-iron rail. However, from the brittle nature of that material, it was soon found to be very unfit for giving support to the great weights which pass along railways. Accordingly, in the year 1811, a malleable iron railway was constructed at Lord Carlisle's coal-works in Cumberland, which forms another important era in the history of the railway, and this system was first publicly noticed in my father's Report of the Edinburgh Railway in the year 1819. Malleable iron has been more or less used since that date, and is now universally employed with the greatest success in the construction of Railways. Indeed, it must be obvious, that the speed at which we now travel, and the liability of cast-iron rails to break, render them quite inapplicable to the improved state of railway conveyance.

Merthyr Tidvil in Glamorganshire, which I visited on my way from Holyhead to Plymouth, is by far the greatest iron district in the kingdom. Here I found the extensive works of Mr. Guest, Mr. Crawshay, and others, directing their whole resources to the manufacture of malleable iron rails for almost all parts of the world. What a striking change in the arts presents itself to our observation, when we consider that it is no more than thirty-five or forty years since the attention of the engineer was wholly engrossed in the formation of canals; and Europe and America were without an iron railway excepting that of Colebrook Dale in Shropshire.

Before describing the Dublin and Kingstown railway, it will be proper to notice the Harbour of Kingstown, between which and the city of Dublin this railway forms a connexion. Through the kindness of Mr. Thomas, engineer for the harbour works at Kingstown, I lately made a visit to that place. The navigation of the River Liffey to Dublin, is only practicable for vessels of small burden in certain states of the tide, and even then is tedious and uncertain, a circumstance which forms a great bar to the commercial prosperity of Dublin, and renders its quays unsuitable as a post packet station. These considerations, together with the want of an asylum harbour for the shipping of St. George's Channel, induced Government to establish a harbour at

Kingstown, upon a scale suitable as a rendezvous for his Majesty's ships of war. This magnificent work, which is now drawing to a close, was originally designed by the late eminent Mr. Rennie. It has been in operation for eighteen years, and is expected to cost, when completed, about one million sterling. The harbour is formed by the projection of two great breakwaters into the sea, inclosing a space of no less than 250 acres, with a depth of 4 fathoms at low-water at its entrance.

During my stay at Kingstown, I had the honour of an introduction from Colonel Burgoyne, of the Board of public Works in Ireland, to Mr. Vignoles, the eminent engineer for the Dublin and Kingstown Railway, which afforded me ample opportunity of examining that work, and as i ossesses several peculiarities in its details, and as some improve nts have lately been introduced there, I shall endeavour to not its principal features to the Society. The Kingstown Rail is five and a half miles in length. For the first mile out of ublin, it is carried on an embankment, supported between two ing walls of masonry and thus elevated, it passes over several eets in the suberbs of the city on elliptical arches of about 30 fee pan, and 7 feet rise. To the extent of about two and a half miles ore reaching Kingstown, the railway is carried along the margin of Dublin Bay, on another embankment, which, on the side exposed to the wash of the waves, is defended by a rough talus wall or bulwark of granite masonry.

The erection of these extensive sea-walls and embankments, together with compensation for damages done to some valuable estates, through which the railway passes, rendered this line very expensive; the cost being about 40,000*l.* per mile, or upwards of 6,000*l.* per mile more than the Liverpool and Manchester railway. The several works on the line are executed with great taste, and the whole is lighted with gas from end to end, and is provided with a very efficient police establishment.

The lines of draught or *gradients* (a term for which, it is believed, the profession is indebted to Mr. Vignoles,) are very easy, the greatest rise being at the rate of one in four hundred. This rise on the line was judiciously introduced for about one mile and a half at the Dublin end, in order, as before noticed, to raise the railway over several of the approaches to the city. Its greatest curve or turn, which occurs near Kingstown, has a radius of half a mile.

Perhaps the most peculiar feature in this railway, is the circumstance of its being devoted exclusively to the conveyance of passengers and their luggage. The trains of carriages start every half-hour, and the fares vary from 6*d.* to 8*d.*, and one 1*s.*, according to the class or description of vehicle travelled in. It is truly astonishing, that, for passengers alone, the receipts on this railway, of only five and a half miles in length, for the year

1835, were no less than 31,066*l*. 8*s*. 6*d*., and no fewer than one million sixty-eight thousand and eighteen passengers were conveyed upon it. The time occupied in making the journey is generally about 17 minutes, or at the rate of nineteen and a half miles per hour, including stoppages.

This railway, like the Liverpool and Manchester, and most other roads on which there is much traffic, consists of two distinct ways or roads, but the space between them, instead of being four feet eight and a half inches, as is generally the case, is eight feet, which, however, renders the middle of the road unavailable for running wagons during the progress of the work, or in the event of any accident happening to the outer rails.

The joinings of the rails occur at every fifteen feet, and are made to rest on what are called *through-going* blocks of granite, or in other words, instead of each rail resting on an insulated stone of the usual dimensions of two feet square, one large block of six feet in length, two feet in breadth, and one foot in thickness, is made to support both of the rails, and in that way to form a connexion between them. On examining these blocks, I found many of them split, caused no doubt by undue pressure, arising from the difficulty of procuring a solid bed for so large a stone. Mr. Vignoles, it is believed, has recommended their removal, and the substitution of the common insulated block. The object in adopting this sort of block was to form a road as perfectly rigid or inflexible as possible. It is also useful in preventing the rails from being separated, which, especially on sharp curves, is apt to take place. This connexion between the rails on the Newcastle and Carlisle Railway is formed by means of a bar of malleable iron, with a cheek formed at both ends as a seat for the rails, while the bar itself rests on the stone blocks. In this way, the objections arising from the expense of procuring large blocks of stone, and their liability to break, are obviated. On the Dublin and Kingstown Railway, they are much troubled by the tendency which the chairs have to shake loose from the granite blocks; to counteract which, the use of felt, wood, lead, and copper, has been applied as a bedding for the chair, but with little effect. The rails of the Liverpool and Manchester line are more easily kept in repair; here, freestone blocks, measuring two feet square, are used for supporting the rails, but the mode of fixing these to the chairs is more simple than on the Dublin and Kingstown Railway. The method, however, of fixing the chairs to the blocks is the same in both cases. The difficulty experienced in keeping the Dublin and Kingstown Railway in repair may arise in a great measure from the rigidity of the rails, produced by the unyielding nature of the granite blocks. Between Liverpool and Manchester, the part of the road requiring least repair is that over Chatt Moss, where the railway may be said to float on the surface of the bog. The motion of the trains

in passing over this part of the line is also sensibly retarded. The weight of the train causes a depression or hollow in the road which offers the same resistance as a gentle inclined plane, to the progress of the engine. This is a good practical proof that a flexible railway offers more resistance to the motion of a carriage passing along its surface than one which is in a more rigid state, while it possesses the advantage of being much more easily kept in good repair.

When the curves on this line of railway are of small radius, the external rail is raised a little above the level of the internal one. On the curve of half a mile radius at Kingstown the difference of level between the two rails is one inch. This is certainly good in theory, and may serve to check the centrifugal force, which in a body moving rapidly round a curve of so small radius must be considerable. The raising of the external rail on curves is not peculiar to the Dublin and Kingstown Railway, and has been introduced with good effect on different works. The trains run round the curve of one half mile in radius, at the rate of twenty miles an hour, and no accident has ever happened. On the Liverpool and Manchester Railway the curves are not so sharp as to render this precaution at all necessary.

A great improvement has been effected in the working of the carriages at the Dublin and Kingstown Railway, by the application of spiral springs to the *buffing*-apparatus of the carriages, for softening their collision; as suggested by Mr. Bergin of the Railway Company. These spiral springs are about three feet in length, and consist of an ingenious combination of shorter springs, varying in strength. By this means, when a carriage strikes gently on any obstruction, the weaker part of this combined spring is alone affected,—and when the collision is more violent, the stronger parts are brought into action. This arrangement has rendered the shocks formerly felt in starting and stopping the carriages much more gentle, and is certainly a valuable and highly useful application of the spiral spring.

The locomotive engines used on the Dublin and Kingstown Railway were made in England. Several of them have vertical cylinders, which both here and at Liverpool have not been found to act so well as those in which the cylinders are horizontal. One engine on the Kingstown line has been constructed to carry its own fuel and water, and thereby dispenses with the use of a tender. This engine, with its apparatus, weighs about twelve tons, and I believe acts very well.

I beg in conclusion to remark, that, with the exception of the peculiarities now mentioned, the observations which I formerly made to the Society, on the details of the Liverpool and Manchester Railway, are generally applicable to the railway between Dublin and Kingstown.*

* Jameson's Edinburgh New Journal, No. 40.

STEAM-PLOUGHS.

THE adaptation of inanimate power to the tillage of the soil must evidently have been considered by practical men to present almost insuperable difficulties, or steam would, probably, long since have been substituted for horses and oxen, as the motive power of agricultural implements. Certain light operations of the farm, such as thrashing, churning, chaff-cutting, &c., which could be performed by fixed power, have partially occupied the attention of mechanics, and suitable machinery driven by water, wind, or small steam-engines, has to some extent been advantageously used for such purposes. But the idea of a "steam farm," of a farm to be altogether cultivated by steam, in lieu of animal power, has hitherto been treated as visionary and absurd, except by a few individuals, and one or two agricultural societies, who have enforced, in their publications, the practicability and importance of applying steam to effect the more laborious operations of agriculture.

This desideratum is at length accomplished. Mr. Heathcoat, M.P. for Tiverton, the ingenious and well known inventor of the lace machinery, has the merit of having conceived and planned this additional and remarkable contribution to science and to the wealth of his country. The invention, after years of costly experiment, has been matured and perfected through the enterprising liberality of Mr. Heathcoat, assisted by the mechanical ingenuity and perseverance of Mr. Josiah Parkes, civil engineer, whom he selected to carry his designs into effect. The first machine has been constructed expressly for the cultivation of bogs, and has, for some months, been practically and successfully worked in Lancashire, on Red Moss, near Bolton-le-Moors.

During the Whitsuntide recess of Parliament, a numerous assemblage of gentlemen from different parts of the country attended to witness an exhibition of this novel and interesting invention; amongst whom were Mr. M. L. Chapman, M.P., Mr. T. Chapman, Mr. H. Handley, M.P., Mr. J. Featherstone, of Griffinstown-house, Westmeath, (an enterprising and successful bog-reclaimer,) Mr. F. Brown, of Welbourn, Lincolnshire, Mr. James Smith, of Deanston, near Stirling, (well known to the mechanical world by his ingenious inventions, applied both to agriculture and manufactures,) Mr. B. Hick, and Mr. P. Rothwell, engineers, with other experienced judges of mechanical contrivances. These gentlemen were unanimous in pronouncing the invention to be the germ of great improvements in the science and practice of agriculture, as well as eminently fitted for the particular purpose to which it has, in the first instance, been applied. Two ploughs of different construction were put in action, to the admiration of the spectators; particularly the one last invented, which is double-acting, or made with two shares in the same plane, so that it returns at the end of a "bout," taking a new furrow, without loss of time. The perfect mechanism of this plough—the action of the working coulters and under-cutting knives, which divide every opposing fibre of the moss—the breadth and depth of the furrow turned over—the application of a new and admirable means of traction, instead of chains or ropes—together with the facility with which the machine is managed, and the power applied to the plough, especially interested and surprised all present. The speed at which the plough travelled was 2½ miles per hour, turning furrows 18 inches broad by 9 inches in depth, and completely reversing the surface. Each furrow of 220 yards in length was performed in somewhat less than three minutes, so that in a working day of twelve

hours, this single machine would with two ploughs turn over ten acres of bog land!

The machine which bears the steam-engines is itself locomotive; but as the ploughs are moved at right angles to its line of progress, not dragged after it, the machine has to advance only the width of a furrow, viz. eighteen inches, whilst the ploughs have travelled a quarter of a mile; in other words, the machine has to be moved only eleven yards, in the time that the ploughs have travelled five-and-a-half miles, and turned over a statute acre of land. This is, in truth, the prime distinguishing feature of the invention; it is the contrivance on which the genius of its author is more particularly stamped, and which seems to be essential to the economical application of steam to husbandry; for it is evident, that were it requisite to impel the machine with a velocity equal to that of the ploughs, by dragging them with it, a great proportion of the power of the engines would be uselessly expended.

Another valuable property appertaining to the machine, and which conduces greatly to its economy as a bog cultivator is, that it requires no previous outlay in the formation of roads, no preparation of any kind further than a drain on each side of it. That a locomotive machine of such great dimensions and power could be so constructed as to travel on mere raw bog, was an excellence the more appreciated as it was unexpected by those persons who are conversant with the soft, unstable nature of bog. The Irish gentlemen present also pronounced Red Moss to be a fair specimen of the great mass of the flat, red, fibrous bogs of Ireland, and that neither the machine nor the ploughs would have any difficulties to encounter in that country which had not been already overcome on Red Moss, the field of experiment. The engines are capable of working up to fifty horses' power, but the operations subsequent to ploughing will require a small force compared with that necessary for breaking up the surface of the bogs, to the depth and at the speed effected by these ploughs. The power consumed by each plough is estimated at about twelve horses, and the weight of the sod operated upon by the plough, from point to heel, is not less than three hundred pounds. The boiler is of unusually large dimensions for locomotive engines, being suited to the use of peat as fuel, so that the culture of a bog will be effected by the produce of its drains. At Red Moss, however, coals are so cheap, being found contiguous to and even under it, that they are used in preference to turf. Eight men are required for the management of the machine and the two ploughs, or at the rate, nearly, of one man per acre; but it must be understood that this number of men will only be required for the first heavy process, and has no relation to any subsequent operations in the cultivation of bogs, nor to the application of the invention to the culture of hard land.

After passing a sufficient time on the Moss to witness the exhibition of the ploughs, and the various other functions and properties of the machine, the party expressed to Mr. Heathcoat the extreme pleasure they had received, and their earnest hope that he would extend the sphere of his exertions by applying the invention to the culture of stiff clay soils; and more especially to carry into effect those important operations of sub-soil ploughing and improved drainage recently introduced to the agricultural world by Mr. Smith, of Deanston. To effect these processes, great power is essential, and it was evident that Mr. Heathcoat's inven-

tion was equally well adapted to them, and would be attended with results no less important than those which will arise from its application to the reclamation and culture of bogs.*

EFFECT OF DRAWING, ROLLING, ANNEALING, &c. OF THE METALS.

In a paper on the ductility and malleability of certain metals, and on the variations of density which they undergo by different operations, M. Baudrimont developes the following interesting facts.

At a temperature rather above a cherry red, iron wire remained three months, surrounded by charcoal, without cementation taking place. A white heat, in five minutes, gave the properties of cast-iron to a square bar of maleable iron of four-tenths of an inch on a side.

Wires of copper, and of alloys of copper and zinc, are increased in diameter, and diminished in density, by annealing. The operation of rolling condenses the metals more than that of wire-drawing. The density of iron and copper is greater, if the metals are heated before being passed through the rollers. The reverse is the case with alloys of copper and zinc. The density of the metals is greatest when drawn into very fine wires.

Wires may be increased in length in two ways, by a diminution in the area of their cross section, or by increasing the distances between their particles. When wires are lengthened in the manner last named, they return to their former length by annealing.

Hydrogen has an action on copper and silver, at high temperatures, which permanently separates their particles. On alloys of copper and zinc, and even of silver and copper, it has no such action.

Wires of different metals, which, after passing through the same hole in the wire-drawing plate, have different diameters, acquire equal diameters by annealing.

The diameter of a wire increases, very slowly, by time, after passing through the wire-drawing plate. Wires which have been bent, and then straightened, re-acquire a curviture.

Wires exposed to a high heat, lose a part of their tenacity. They require to be annealed in wire-drawing, not to render them more tenacious, but to allow the particles to resume the positions from which they may again be displaced. The loss of tenacity is common to copper, iron, platinum, and the alloys of copper and zinc.

Brass wire approaches to iron in strength, while copper is inferior to it. Brass may be used instead of iron, where the latter would oxidate too rapidly.

The iron wires are given at strengths from 79,000 lbs. to the

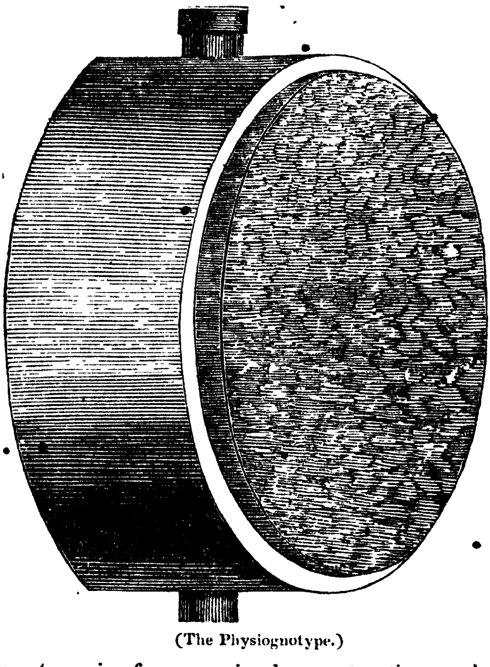
* Morning Chronicle.

square inch to 127,600 lbs. The brass wires, from 78 to 87,000 lbs. to the square inch. Copper, from 38 to 44,000 lbs. The diameters of the least and greatest wires were. iron, ·014 inch, and ·205 inch; brass, ·070 and ·267 inch: copper, ·019 and ·285 inch.

The finer wires bear greater weights, in proportion to their areas, than the coarser ones, because the particles of the former are compacted through the whole cross section, while those of the latter, for a certain depth only, are thus forced together.*

THE PHYSIOGNOTYPE.

The accompanying engraving represents a machine for taking casts, lately invented by a gentleman in Paris. It is called the



(The Physiognotype.)

Physiognotype, is of a very simple construction, and takes the exact imprint of the countenance without any disagreeable sensation, by an application of less than two seconds.

* Annales de Chimie et de Physique, quoted in the Mechanics' Magazine, No. 672.

This instrument is a metallic, oval plate, pierced with a large quantity of minute holes very closely together, and through each of which a wire, (very like a knitting-needle,) passes with extreme facility. These needles have the appearance of a brush. The whole is surrounded with a double case of tin, which contains warm water, in order to keep the instrument of a proper temperature with the blood. If any figure be applied against this brush of needles, it will yield to the slightest pressure, and leave an exact mould. The needles are then fixed by a very simple process, and from this metallic mould the cast is taken. There is nothing disagreeable in the application of the instrument, but the sensation cannot well be described; although, if the Physiognotype were not heated, it would feel like immersing the face in snow. The impression left will be an accurate likeness, and the mask will be a fac-simile of the mould. Nothing is wanting; even a vein on the temple is faithfully represented.*

(Section, showing the Impression of the features.)

NEW MODE OF HEATING APARTMENTS.

At the Royal Institution, on the 11th of March, Dr. Arnot showed that the expense of heating rooms in the usual way by an open fire is enormous, in consequence of the waste of heat. In a chaldron of coals, one half of the heat produced is sent up the chimney, while the remainder radiates into the room; but one half of this is also subsequently sent up the chimney, which is principally occasioned by the width of that aperture. Hence, three-fourths of the fuel is actually wasted. In cold countries an open fire cannot be employed, because it is not capable of heating a room when the temperature of the air is very low. Stoves are, therefore, used; but an objection to stoves is, that

* Mirror, No. 801.

they become red hot and send too much heat up the chimney. On this account they are often surrounded by porcelain and brick-work. In manufactories, steam pipes and hot air are employed to impart a regular temperature to rooms, without which the cotton yarn would be injured. Dr. Arnot tried to heat his library by means of a hot water box communicating with the kitchen; but he found the expense (30*l*.) too great. He then thought of heating the water in the box itself, and thus making it portable; and, lastly, he contrived a hot air box of simple construction, which answers the purpose completely. It consists of a square box of plate iron, formed of two chambers, which communicate at the top, capable of containing any quantity of air in proportion to the size of the room. On one side at the bottom there is a tube which conducts fresh air into a small porcelain furnace inclosed in the box. This air, after supplying oxygen for combustion, passes to the upper part of the box, and circulates into the posterior chamber, where there is a chimney. To prevent the air from becoming too hot, a valve is adjusted to the box, formed of a double bar of iron and brass, which opens in proportion to the temperature. Dr. Arnot finds that it requires no attention, that a sufficient quantity of fuel deposited in the furnace in the morning lasts for 24 hours, and thus produces a very great saving of fuel. The heating surface may be increased by having two or more of these boxes at any distance connected by tubes. Dr. Arnot described a method of ventilating rooms by having two parallel tubes, one of them supplied with a fanner to extract the air, and the other with a similar contrivance to force in air.*

RAILROAD BETWEEN BRUSSELS AND ANTWERP.

THE execution of the railroad between Brussels and Antwerp was divided into two sections: the first reaching from Brussels to Malines, a distance, by the rails, of thirteen and a half English miles; and the second, from Malines to Antwerp, fourteen and a half miles. The Brussels and Malines line has been completed, and traversed regularly by carriages for some time. The Malines and Antwerp line has been recently completed, and on the 4th of May was opened at Antwerp, in the presence of the king, queen, and court of Belgium, with great ceremony. The design, proposed advantages, and important consequences, of the undertaking, were pointed out in an address to the king, delivered by M. Rogier, the governor of Antwerp, to whom Belgium is principally indebted for the first impulse on the subject. He described it as the means by which Belgium is to be rendered by land what England and Holland are by sea,—a carrier of general commerce. " Antwerp is now but an hour from Brus-

* Thomson's Records, No. 16.

sels; the railroad is a link of that immense chain which, in a little time, will connect every state. In six or seven hours we may then enter Paris; in sixteen, Berlin; in sixty, Petersburgh. Upon a railroad, the tour of the world might be made in six weeks."

The country through which this Belgian line runs, presents, as might be expected, none of the usual causes of extra expense; no extensive viaducts, large bridges, or tunnels, were necessary. The clivities were extremely moderate; on the Brussels section, the greatest difference of level between any two points of the road is but thirty-two feet; on the Antwerp section, thirty-six feet. The engineers were Messrs. Simmons and De Ridders, whose talents and exertions are spoken of as eminent and successful. The total cost of the whole line, exclusive of locomoteurs and wagons, was 3,200,000 fr. = 128 000*l*., or about 4,500*l*. per mile.

Six journeys per day are now made from Brussels to Antwerp, and *vice versa*, between half past 6 A.M. and half past 6 P.M. The trains start simultaneously at Brussels and Antwerp, and meet at Malines. The whole length, including stoppages, is stated to be run in an hour and a half, and the average velocity to be twenty two miles per hour. There are four kinds of carriages for passengers in each train. The Berlines at 3½ francs—about 3*s*.; the Diligences at 3 fr.—2*s*. 6*d*.; the Char-à-bancs (covered), 2 fr.—1*s*. 10*d*.; and open wagons at 1 fr. 20 cents—1*s*. 2*d*. This means of reaching Brussels six times a day in an hour and a half, will give Antwerp an important advantage over the other steamer sea-ports. Two of the locomoteurs, the Stephenson, and another, were built in England; the other two, La Belge and L'Anversoise, one of 10, and the other of 20 horse power, were constructed by Mr. Cockerill, in Belgium, at Seraing.

When the whole system of railroad, now contemplated in Belgium, is completed, and which is sanguinely looked for by the end of 1839, Malines will be the centre from which four most important railroads will radiate, viz., those of Brussels, Liege, Antwerp, and Ghent. Nothing will then be wanting to crown the undertaking with abundant success but that amelioration of the duties which M. Rogier entreated of the king,—that liberal system of transit and bond, by which merchandise, as well as passengers, may traverse the kingdom, from the sea to the continent, and *vice versâ*, with scarcely any evidence of its having changed elements or country.*

IMPROVED METHOD OF CASTING BRASS BURRS.

The usual method of accomplishing this object is to place the screw in a mould of the required form, and to cast the brass

* Magazine of Popular Science, No. 5.

about it, by which means a very perfect burr may be produced; but there is frequently great difficulty in removing it from the screw. To avoid this, it is proposed to cast a lead burr in the usual way, (which may be easily taken off,) and to use it as a box for the formation of a sand *core*. After the box is filled, it is subjected for some hours to the heat of the drying-stove, and when its contents are found to be perfectly free from moisture, the whole is plunged into the melted lead, which robs the core of its casing, and renders the sand copy fit for use instead of the original screw: by this means the difficulty above alluded to is entirely obviated.*

ROTATORY PRINTING MACHINE.

By Mr. Rowland Hill.

THE steam printing press was introduced at the close of the year 1814, before which time all printing was done by hand presses, and the rate at which large sheets, as newspapers, were printed, scarcely ever exceeded 300 single impressions† in an hour.

The insufficiency of the hand press to meet the growing demands of the public for newspapers was probably felt at a much earlier time, as in the year 1790, Mr. William Nicholson, editor of the journal bearing his name, obtained a patent for machines for printing upon various plans, and it is certainly the case that he then indicated very many of the modes of operation which, since his time, have been successfully developed by other machinists. Mr. Nicholson appears never to have carried out any of his plans to a successful termination. Whether he was unable to work out the numerous mechanical details, or wanted funds to meet the heavy and unavoidable expense of such undertakings, or could not induce those engaged in the trade to give his plans a fair trial, we have no means of ascertaining; certain it is, that whether succeeding machinists have or have not been indebted to him for their leading views, they have had still to encounter by far the most difficult part of their task; and in overcoming the various physical and mechanical difficulties which lay in their way, their powers of invention, and their patience, and industry, must have been exercised in no ordinary degree.

When, however, the machine presses were brought into action, a great increase of speed was at once obtained.

During the twenty-one years which have elapsed since their introduction, various and important improvements have been effected in their construction; and, by the rapid and powerful machines now used in printing the daily newspapers, the sur

* Third Report of the Cornwall Polytechnic Society, quoted in the Mechanics' Magazine, No. 668.

† Impressions on one side only of the sheet of paper.

prising number of 4,000 single impressions is sometimes given off in an hour.

The inventor of the machine, which is the subject of this paper, believes that he has effected improvements by which the rate of printing just named, great as it is, may be still further increased, and that in no trifling degree.

In order to explain the means by which this advantage is proposed to be obtained, it is necessary to notice shortly the construction of the machines now commonly in use.

The types necessary to the printing of one side of the sheet, consisting (for a newspaper) of about 100,000 separate pieces, are collected, and being arranged in proper columns, the mass is placed in an iron frame, called a *chase*, which binds it firmly together, and the *form* (as the chase filled with type is technically called) is then transferred to the machine, where it is secured upon a strong iron plate, which plate being mounted upon truck wheels, forms a carriage; and there is a small railroad for it to run upon.

When the machine is in action, this carriage, with the form upon it, of which the face* of the type constitutes the upper surface, is constantly moved backward and forward horizontally, and as it passes along, it comes in contact, first, with the inking apparatus, which consists principally of a number of cylindrical rollers covered with ink and lying horizontally, and which are set in motion by the friction of the surface of the type acting upon their lower sides as it runs under them.

Next the form, being now inked, passes under a large revolving iron cylinder, about the form and size of an ordinary double drum; this lies horizontally, and its curved surface is covered by a closely wove blanket bound tightly upon it.

The paper, as it is supplied to the machine, is made partly to encircle this cylinder, being held against it by tapes which move with the cylinder.

The surface of the type moving horizontally, and the surface of the blanket-covered cylinder revolving with the paper upon it, have exactly the same speed, and as the type passes under the cylinder, that side of the cylinder which bears the paper is brought undermost and presses the paper upon the type, whereby it is printed. The cylinder then rises a little, the type returns under it without contact, and passes back to the inking-rollers for another supply of ink, preparatory to the printing of another sheet; while the printed sheet, if the machine be constructed to hold one form only, now passes out from between the cylinder and the tapes, and is received by an attendant.

Simple and ingenious as this arrangement undoubtedly is, the experienced machinist will at once perceive that it has points in which improvement is at least highly desirable.

* That part which gives the impression.

That which is most objectionable is the reciprocating motion of the form and its carriage, which together are of considerable weight, varying perhaps from five cwt. to a ton; and it is obviously difficult, if not impossible, to keep such a heavy mass in very rapid motion, when the direction of that motion has to be reversed every instant.

Also, much time is occupied by the backward motion of the form by which the type obtains a supply of ink, and regains the position proper for the printing of a succeeding sheet.

And the rate of reciprocating motion really obtained, though not great, requires much power to produce it.

These defects appear to be unavoidable while the type forms a flat surface, as it is not practicable to make a flat surface move continuously.

Mr. Hill proposes to obviate these defects by affixing the type around a cylinder, so that the surface of the type itself shall form a kind of outer cylinder, the whole resembling slightly an organ-barrel with its projecting pins; and he has certainly overcome the principal difficulty as it appears, viz., the discovery of a mode of readily and securely attaching the pieces of type to the cylinder, and this without making it difficult to detach them for the purposes of correction, revisal, &c. Of the manner in which this is accomplished we shall speak presently.

The type so affixed upon a cylinder, together with the proper spaces for margin, occupy its whole circumference; the cylinder thus clothed is placed in contact with a blanket-covered cylinder of the same dimensions, and the two are connected by toothed wheels, and the paper is passed between them with moderate compression, just as a piece of metal is passed between the rolls of a flatting-mill. An inking apparatus is attached, by which a constant supply of ink is communicated to the type as it revolves.

As the type cylinder has affixed to it precisely the quantity of type requisite for printing a sheet on one side; and as there is no vacant space upon the cylinder except for the margin, it follows that at each revolution of the cylinder exactly one sheet will be printed; and that the instant the printing of one sheet is completed, that of another will be commenced; no loss of time, therefore, can occur, if the supply of paper and of ink be kept up.

Again, the motion being rotatory, not reciprocating, there is no difficulty in making it rapid; and the machine has been repeatedly worked with great rapidity in the presence of numbers of persons, without injuring or disturbing any of its parts, and without deteriorating the quality of the printing.

In the machine which has been exhibited, there are two type*

* One only has been covered with movable type, the other has stereotype plates bound round it as a temporary arrangement.

cylinders and two blanket cylinders, placed thus ○ ○ : *the* paper, in passing from left to right between the first rollers, is printed upon its upper side, and in passing between the last rollers it has its lower side printed.

This arrangement, of course, requires two distinct inking apparatus, one for each type roller.

To supply the machine with paper in single sheets at the rate of two per second, at which rate the machine has hitherto been worked, would be difficult, if not impracticable; the plan, therefore, has been to make use of a long scroll of paper, as it is produced by the ordinary paper-machines, the end of which being introduced between the rollers, the machine then supplies itself by unwinding the scroll from a reel.

It is intended to cut the scroll up into single sheets by additional machinery, as it passes from the printing rollers.

The greatest difficulty which Mr. Hill has had to surmount in the construction of his machine, is, as we have already stated, that of fastening the small pieces of type upon the surface of a cylinder, and with firmness to retain their places even when they are turned upside downwards by the revolution of the cylinder, at which time their gravity combines with their centrifugal force in tending to displace them, and to effect this without throwing new difficulties in the way of correction, revisal, &c. We shall endeavour to explain how this is accomplished.

Each piece of type is slightly wedge-like in its form, so that when several are laid side by side, they form a segment or arch, whose lower curve corresponds to the surface of the cylinder upon which the type is to be fixed,* and each piece, instead of the ordinary narrow notches to its side, made for the compositor's convenience, has a very broad notch; when the type is placed together to form a line, these broad notches in the several pieces range together, and form an arched chase capable of receiving a thin brass plate of corresponding form and dimensions, which, when applied, is wholly embedded in the chase. When a line of type, with its plate, or scale-board, so embedded within its substance, is compressed between the lines, and its plate thereby completely inclosed and kept in its place, it is manifest that no single piece of type can be displaced: if any move, the whole line must move. Means have been adopted, which we have not space to describe, by which these plates are made to take their places in the course of the composition, with the utmost readiness and certainty.

* Mr. Nicholson proposed to use wedge-like type, and to affix them upon a cylinder, but he did not show any sufficient means of so affixing them.

The lines of type are placed in a kind of tray or galley, of the length and breadth of a newspaper column; the bottom of which tray is a portion of a cylinder, the curvature being in its breadth, not in its length, somewhat as though a stave were taken from a truly cylindrical cask, and used as the bottom of a tray, the curved side being uppermost. The lines of type are secured in the tray principally by horizontal screw pressure acting against the ends of the column of type; but, as a precaution against a tendency to bulge, which sometimes occurs in a column of the great length required in a newspaper, a few of the embedded plates have small projecting tenons at their ends, which lock into certain chases in the sides of the tray just described.

The upper type cylinder of the machine exhibited has ten such trays, answering to the ten columns upon one side of a newspaper;* each tray being filled with type, has a proof taken from it by a small press, and, after correction, the type being made fast by tightening the horizontal screws with which the galley is provided, the galley itself is screwed upon the cylinder. When the ten galleys are so attached to the cylinder, they cover it completely, excepting the spaces left for margin, but any one galley can be easily removed and replaced without disturbing any other.

The galleys filled with type being firmly screwed to the cylinder, thenceforward form part of it, and are not removed until the printing is completed and the type is to be taken out for distribution, unless it should become necessary to stop the press for further revisal or the insertion of new matter.

The very rapid supply of ink which the machine demands, by reason of its great speed, appears to be fully maintained, and that with very good colour, by the inking apparatus attached.

Mr. Hill employs the trough (for containing the ink), with its ductor-blade and iron roller, having proper screws for increasing or diminishing the space between the blade and the roller, through which space a thin film of ink adhering to the surface of the roller passes from the trough as the roller revolves.

This ductor is in every respect of the usual construction; its roller turns very slowly: next to it Mr. Hill places another iron roller, lying parallel with it and just touching it, but having a rapid motion, equal to that of the surface of the type; and this roller, by gently, but swiftly, rubbing against the ductor-roller, takes off its ink in a much thinner and more extended film. It ordinarily moves about eighteen times as fast as the ductor-roller, therefore it ordinarily extends the film of ink brought out by the slow moving ductor-roller over eighteen times the amount of surface it first occupied.

* The lower type-cylinder, which prints the other side of the paper, is temporarily covered with stereotype plates, as before named.

Means are provided by which the relative speed of the ductor can be readily increased or diminished; and thus a very nice adjustment of the quantity of ink supplied to the type can be effected.

We have spoken incidentally of the great speed of Mr. Hill's machine; being worked by two men, it throws off sheets of the size of the evening newspapers, at the rate of 7,000 to 8,000 perfected copies per hour. What rate can be safely given to it by the application of steam power it is difficult to determine. At the speed above named, a scroll of paper of the width of a newspaper, and from three miles and a half to four miles long, might be printed on both sides in one hour.

Before the introduction of printing machines in 1814, the printers of large newspapers, confined in their operations by the slowness of the hand press, had no resource, under the pressure of urgent demand, but to set up a portion of their matter in duplicate, at an expense of some thousands per annum. It seems not improbable that the expected abatement or removal of the stamp duty may soon cause the demand for newspapers to overtask even the great power of the present machines.

Should such a pressure arise, and should Mr. Hill's machine prove as successful in extended practical operation, as the numerous experimental trials it has had give reason to expect, its introduction will probably bring relief in the same way as it was brought by the introduction of the machines first used.*

MINING MACHINERY.

On March 10th, Mr. Taylor delivered before the Society of Arts, a lecture on recent improvements in the machinery of mines. After a few words on the origin and progress of mining, Mr. Taylor directed the attention of his numerous auditory to the introduction of the steam-engine, which, of all other contrivances, was the most important and effective in raising to its discharge that immense volume of water which constantly flows in upon the miners, impeding and frequently overwhelming them. Savory's was one of the first steam-engines so employed—it was called "the miner's friend." Smeaton had calculated that the quantity of water thrown up by steam previously to recent improvements, was in the ratio of 5,500,000 lbs. 1 foot high, to every bushel of coals consumed. These marvellous improvements, however, have been carried to such a height, that the above ratio is now increased to 90,000,000 lbs.; and in short, experiments made in some of the English mines last year, it appears that the quantity was 125,000,000 lbs. With this surprising advance in the working of mines, copper is as high in price now as it was in the days

* Repertory, No. 35.

of William and Mary, viz. 120*l*. per ton. Mr. Taylor's statement was rendered very interesting by the variety of statistical details it embraced, drawn from parliamentary returns and other authentic sources, in reference to the mines of Mexico, Germany, Devonshire, Cumberland, and Cornwall. A beautifully executed map of the ramifications of the consolidated mines of the latter place was exhibited and ably explained. Some idea of the magnitude of these mines may be formed from the fact, that they are 45 miles in extent, and that the principal shaft is 290 fathoms below the level of the sea. Several other interesting particulars were mentioned; among which we may notice a method of expelling foul air from the shafts of mines, (the invention of the lecturer, and which, some years since, obtained a prize from the society,) and a recently proposed and very ingenious mode of raising the workmen from the bottom of the shaft, by which they will be spared the necessity, as at present, of climbing to the surface by many hundred steps—a labour so severe, especially to men already exhausted with their day's work, as to deter all but the young and vigorous from descending to the greater depths. The lecture was illustrated by some beautiful models; and several choice specimens of native silver, copper, &c., were placed on the table.*

ACCOUNT OF A RECENTLY INVENTED PATENT SPRING, CALLED, "THE SAFETY SPRING," FOR CARRIAGES AND CARTS.

By the Rev. R. J. Barlow.

WHEN springs were first brought into practice, they were imagined to be useful merely to give ease to the traveller, and a certain degree of security to fragile articles; reflecting persons, however, quickly discovered them to be a great means of saving the carriage and lessening the draught, which latter is clearly proved in the works of Drs. Helsham and Arnot. To save the road upon which we travel, has since the formation of railways become a consideration of the utmost importance, and so perfectly convinced are scientific men of the value of springs for that purpose, that the eminent engineer Mr. Stevenson does not permit a single wagon to be run upon the Manchester and other lines under his direction without springs, although the weight and expense thereby added to each wagon is very considerable.

Hence, it is evident, that besides the comfort and convenience of springs, their chief advantages consists in saving the horse or engine, the carriage itself, and the road upon which it travels; and consequently the only argument against their being universally adopted by the Ordnance Department, and for farming

* Literary Gazette, No. 999.

carts, and common stage wagons, must arise from their being so expensive, so liable to break, and so ponderous when employed for heavy wagons, all which evils are in a great measure obviated by this invention, the peculiar properties of which may be thus briefly enumerated:—

A greater degree of ease than those now in use;—almost perfect security against breaking under any circumstances;—a saving of weight upon railways to the amount of three-fourths, upon the common roads to the extent of two-thirds;—much cheaper; —a direct up and down motion, which prevents the swinging and rolling of the carriage, and consequently secures it against being overturned under any extent of load;—simple, capable of being repaired by the most indifferent mechanic,—may, upon emergency, be increased in strength for bad roads and heavy luggage; —preserves the graceful appearance of the C spring so completely as to deceive the eye, and in all other cases is lighter and more elegant than those now in use.

That this spring is easier than those in general practice has been proved by comparing them with some of the best London manufacture for the space of a year, during which they were tried upon the worst description of roads: again upon the Whitby railway, where they have been in use for some months, they are found to have a much more pleasant motion than any hitherto employed. This is attributable solely to the spring being acted upon instantaneously; and completely without friction, which prevails to an enormous degree in the old springs, and renders them stiff or wooden to a great extent.

The superior security of this spring may be proved in this manner. The levers are constructed of two pieces of one-fourth inch plate iron, distant from each other two or three inches, and connected by one or more small blocks of wood, or, as in the case of the C spring, by one solid piece, all firmly rivetted together; by this means the iron receives the strain edgeways, and, like the blade of a saw or knife, supported in such a position, it may, with little weight, be made equal to any load.

The spring itself never exceeds eight or ten inches in length, and consists of several steel plates of a lozenge shape, inserted in a kind of case called a stop, (from its regulating the quantity of motion and stopping it at a certain given limit.) This stop, by its tongue running through the centre, divides the plates into upper and under series, and contains, at each end, a rack or rest for every plate, which being supported at the extremities, the whole spring is pressed in the centre directly like an elliptic spring, and since every plate is supposed to be capable of bending more than it is permitted, it is not possible that the spring can ever break, because it is checked before it reaches the breaking point. Let it not, however, be imagined, that, being thus checked, the motion must be unpleasant, for if the spring be pro-

portioned to the weight, it will never collapse, but with such a shock as might endanger the carriage. It should also be mentioned, that whereas all springs are found to break, or set and lose their shape and original position if too heavily laden, this safety spring will, on the contrary, always return to the same height, when the load is taken off, be it ever so great; for as has been shown, it is impossible to break the spring, and when it has gone home, the strain then comes entirely upon the levers, which are made beyond any, even the utmost calculated weight or strain.

The difference of weight between these springs and the old ones, has been accurately determined at the Whitby Railway, and is as follows:—old springs for a 3 tons carriage, 372 lbs.; new springs for a 3 tons carriage, 90 lbs., being, as stated above, a saving of three-fourths in weight; but it is further to be remarked, that in the old springs, double the load requires double the weight of springs; whereas in this invention, the spring alone requires increase, directly as the weight, a few pounds additional to the levers being sufficient: thus, for instance, on the Whitby line, 3 tons take springs of 90 lbs., but 156 lbs. is sufficient for 6 tons, the levers being increased by only 6 lbs.

The saving of expense is evident from the simple nature of the invention, because all the parts can, without loss of steel or iron, be cut in the cold state by heavy machinery, after which little hand labour is necessary: again it is to be considered that there is never more than one-third of the material employed, and that one-half of that is iron instead of steel.

The direct up and down motion will thus appear. In all cases such as public coaches, phaetons with perches, and gigs, where the springs can be conveniently placed so as to run, not across, but along the axle, should the weight by a jerk be thrown to one side, the lever or levers on that side will work the springs, and those on the opposite side being freed from duty, will fall at the same time, by which means the carriage is compelled to descend at both sides alike, and therefore will move directly up and down only, so far as the springs are concerned; whereas with the present springs, when the weight is thrown to one side, the opposite side of the spring being relieved from pressure, kicks up, and tends much to make the carriage swing and overturn.

The facility of increasing the strength for bad roads or heavy luggage, will be understood by supposing the stop and its racks to be so arranged, as to be capable of receiving at the top and bottom one or more plates. This will materially increase the strength, and may be performed by an ordinary servant. In the levers no change is requisite, as they are always capable of working a spring of much greater power than would suit the carriage under ordinary circumstances.*

* Jameson's Journal, No. 42.

TABULAR VIEW OF THE MANNER, CAUSE, AND EFFECT OF THE DESTRUCTION OF STEAM BOILERS, IN THE SEVERAL CASES IN WHICH IT MAY OCCUR.

*Drawn up by M. Galy-Cazalat.**

STEAM BOILERS, (rectangular and cylindrical,) may be	1. Exploded	(If *large*,) by an excess in the elastic force of steam, beyond the resisting power of the boiler when developed slowly and gradually.	dangerous	1
		(If *large*,) by an excess in the elastic force of steam, developed very rapidly or instantaneously.	dangerous	2
	2. Rent	(If *small*,) by an excess in the elastic force of steam, when the sides† are incapable of an equal resistance in all parts.	harmless	3
		(If *large*,) by an excess in the elastic force of steam, when developed at a certain rate, and when the sides are incapable of equal resistance in all parts.	harmless	4
	3. Crushed	(If *large*,) by pressure of the atmosphere, when the steam is sufficiently condensed.	harmless, or dangerous, according to circumstances	5
	4. Perforated	(If *small* or *large*,) by the contact of a foreign substance (a bad conductor of heat) with the boiler bottom.	harmless	6
	5. displaced	(If *large* or *small*,) by the inflammation of a certain volume of explosive gas in the fire-place and flues, when the former is closed.	dangerous	7
[N.B. The boilers under consideration in this Table, are supposed to be without tubes or partitions, internally; the fire and the flues to be external; the former beneath, and the latter around them.]		(If *large* or *small*,) by the instantaneous developement of a large volume of steam, generated by a sufficient quantity of water falling on a considerable surface of embers.	dangerous	8
		(If *large* or *small*,) by the recoil produced by the destruction of the equilibrium of the internal pressure, in consequence of a large accidental opening.	dangerous	9

* Magazine of Popular Science, No. 8.

† By "sides," is understood (*top-side, bottom-side, &c.*,) the whole inclosing substance of the boiler.

SCIENCE OF THE TIDES.

In the section of Mechanical Science, at the late meeting of the British Association, Mr. Whewell gave a short account of the present state of the science of the Tides. Though there can be no doubt, that the tides are to be reckoned among the results of the great law of universal gravitation, they differ from all the other results of that law in this respect, that the facts have not, in their details, been reduced to an accordance with the theory; and the peculiar interest of the subject at the present moment arises from this, that the researches now going on appear to be tending to an accordance of theory and observation; although much in the way of calculation and observation remains to be still effected before this accordance reaches its ultimate state of completeness. With regard to observation, the port of Bristol offers peculiar advantages; for, in consequence of the great magnitude of the tides there. almost all the peculiarities of the phenomena are magnified, and may be studied as if under a microscope. With regard to the theory, one point mainly was dwelt upon. By the theory, the tides follow the moon's southings at a certain interval of time, (the lunitidal interval,) and this mean interval will undergo changes, so as to leave less than the mean when the moon passes three hours after the sun, equal to the mean when the moon passes six hours after the sun, and greater than the mean when the moon passes nine hours after the sun; and the quantity by which the lunitidal interval is less than the mean when the moon is three hours after the sun, is exactly equal to the quantity by which the lunitidal interval is greater than the mean when the moon passes nine hours after the sun. And this equality of the defect and excess of the interval at three hours and at nine hours of the moon's transit, is still true where the moon's force alters by the alteration of her parrallax or declination. Now we are to inquire whether this equality of excess and defect of the interval in all changes of declination, &c, is exhibited by observation. It appears at first sight, that the equality does not exist; that is, if we obtain the lunitidal interval by comparing the tide with the nearest preceding transit. But, in truth we ought not to refer the tide to such a transit, because we know that the tide of our shores must be produced in a great measure by the tide which revolves in the Southern Ocean, and which every half day sends off tides along the Atlantic. The tide, therefore, which reaches Bristol, is the result of a tide wave, which was produced by the action of the sun and moon at some anterior period. It is found, that if at Bristol we refer each tide to the transit of the moon, which took place about forty-four hours previously, we do obtain an accordance of the observations with theory in the feature above described,—that although the moon's force alters by the alteration of her declination, the defect of the lunitidal interval for a three hours' transit of the moon is

equal to the excess of that interval for a nine hours' transit. And thus, in this respect at least, the tide at Bristol agrees exactly with the tide which would be produced, if, forty-four hours before the tide, the waters of the ocean assumed the form of the spheroid of equilibrium due to the forces of the moon and sun, and if this tide were transmitted unaltered to Bristol in those forty-four hours.*

STEAM NAVIGATION WITH THE EAST INDIES.

A PROSPECTUS has lately appeared for establishing steam communication with British India, to be followed up by steam-vessels to other parts of the East, extending even to Australia. That distant portion of the world, by the proposed arrangment, will be reached at the outset in the short period of 73 days; and when experience is obtained, this time will in all probability be reduced one third; shortening the distance, by the route in question, from England to Australia to 40 days steaming, at 10 miles an hour. If two days be allowed for stoppages at stations, not averaging more than 1,000 miles apart throughout the line, the whole time for passing between the extreme points would only be 60 days; but a relay of vessels will follow, if the undertaking be matured, in which case 24 hours would be ample time at the depôts, and a communication may be expected to be established, and kept up throughout the year, between England and Australia in 50 days.

The prospectus shows that Bombay will be reached in 48 days, Madras in 55, Calcutta in 59, Penang in 57, Sincapore in 60, Batavia in 62, Canton in 68, and Mauritius in 54 days.

It has been stated, that 50 days will be the probable time for communicating with Australia, instead of 73 as above. It is well to begin on the safe side; but this table of distances may be reduced a third throughout; so that Bombay might be reached in 32 days from England, Calcutta in 40, and so on. This is a project which every well wisher to England and her commerce will be desirous to promote It appears to promise complete success For the sums required from government and the East India Company, to enable the parties immediately to proceed, more than adequate services are promised. The mercantile interests of Great Britain furnish the capital, and the Company look to the extension of commerce as a legitimate, and no doubt certain, remuneration. Thus individual advantage will be obtained. The national revenue will be increased; internal sources of prosperity, such as manufactories, will be benefited; and intercourse and industry will be carried to distant regions, some of which are scarcely known by name to Christian Europe. It is a matter of congratulation that England will lead in thus concen-

* Jameson's Journal, No. 42.

trating, as it were, such a mass of the human family, and of bringing numerous savage tribes of Asia and Africa to a knowledge of the advantage to be derived from science and civilization.

The pretext for hitherto withholding this measure, so loudly called for by all India, and sought for by the mercantile interests of Great Britain, and recommended by a committee of the house of commons, has been the plea of expense that would be incurred by the East India Company in carrying out the measure. This sole objection to the arrangement is now unequivocally met by a proposal from the parties in London to open the communication monthly. They ask from the India House only 25,000*l.* a year, for the conveyance of their despatches and letters to and from all India, and thus relieve the India Company of the necessity of expending 100,000*l.* a year, which is the least sum a communication to Bombay alone has been estimated by the India House authorities. His majesty's government will be benefited in the same way, by being asked for a grant of 40,000*l.* a year for the carriage of the Mediterranean mails and their despatches to and from India; whilst for the conveyance of the former alone they at present incur an expense of at least 60,000*l.* annually, a duty which by the merchants of London is considered to be now very imperfectly performed.*

PLUMBAGO AND BLACK LEAD PENCILS.

THERE is only one purpose to which this form of carbon, is applied in the solid state, viz., for the manufacture of black lead pencils, and its adaption to this end depends upon its softness. In the state of a powder, plumbago is used to relieve friction. Its power in this way may be illustrated by rubbing a button first on a plain board, five or six times, and applying it to a bit of phosphorus, the latter will immediately burn. When rubbed on a surface covered with plumbago, double or triple the friction will be required to produce the same effect. One of the most remarkable circumstances connected with plumbago is the mode in which it is sold. Once a year the mine at Borrowdale is opened, and a sufficient quantity of plumbago is extracted, to supply the market during the ensuing year. It is then closed up and the product is carried in small fragments of about three or four inches long, to London, where it is exposed to sale, at the black lead market, which is held on the first Monday of every month, at a public-house in Essex-street, Strand. The buyers, who amount to about seven or eight, examine every piece with a sharp instrument, to ascertain its hardness—those which are two soft being rejected. The individual who has the first choice pays 45*s.* per pound; the others 30*s.* But as there is no addition made to the first quantity in the market, during the course of the

* Nautical Magazine, No. 57.

year, the residual portions are examined over and over again, until they are exhausted. The annual amount of sale is about 3,000*l*. There are three kinds of pencils, common, ever-pointed, and plummets.—The latter are composed of one-third sulphuret of antimony, and two-thirds plumbago.

The 1st part of the process is sawing out the cedar into long planks, and then into what are technically termed tops and bottoms. The 2nd, sawing out the grooves by means of a fly-wheel. The 3rd, scraping the lead on a stone; having been previously made into thin slices, to suit the groove: introducing it into the groove, and scratching the side with a sharp pointed instrument, so as to break it off exactly above the groove. The 4th, glueing the tops and bottoms together, and turning the cedar cases in a gauge.

The *ever-pointed* pencils are first cut into thin slabs, then into square pieces, by means of a steel gauge. They are then passed through three small holes, armed with rubies, which last about three or four days. Steel does not last above as many hours. Six of these ever-pointed pencils may be had for 2*s*. 6*d*. If they are cheaper than this, we may be sure that they are adulterated.

In Paris, when you buy a sheet of paper in a stationer's shop, some of these pencils are added to the purchase. Now these are formed of a mixture of plumbago, fuller's earth, and vermicelli. Genuine cedar pencils must cost 6*d*. each. If they are sold at a lower price, they must be formed from a mixture, not from pure plumbago. Pencils are, however, sold as low as 4½*d*. a dozen.

There is no patent which has been more infringed on than that of Mordan's, for ever-pointed pencils. Birmingham is the source of this infringement, where they are sold as low as ¾*d*. each, formed of composition. A thousand persons are now engaged in the manufacture of these pencils, and pencil-cases.

These facts were stated by Dr. Faraday, at the Royal Institution, April 22nd.*

STABILITY OF THE MENAI SUSPENSION BRIDGE.

The gale on February 23rd, in the Menai Strait, was probably the most violent that has happened since the Suspension Bridge was thrown across it. An intelligent eye-witness of the effect of the wind, has enabled us to state, that the wind, which was from the S.W.,† seemed to descend upon the bridge; and though it produced no lateral motion, it excited an undulation in the long line which is suspended between the supporting pyramids, to such an extraordinary degree, that the wave ran from end to end of the roadway, and measured vertically not less than 16 feet, that

* Thomson's Records, No. 18.

† The direction of the central line of the bridge is nearly N.W. and S.E., so that the wind acted nearly at right angles upon the Carnarvon side.

is to say, that its crest was in one part elevated 8 feet above an horizontal line, and its hollow depressed, at another part, in the same instant of time, 8 feet below it. The highest and lowest points of the wave, occurred at about half way between the pyramids and the centre of the span. The undulation was steady and uniform, but the swell across the roadway was not so, and this threw it out of level, one side being the highest at one moment and the other side at another. This irregularity disturbed some of the planking, and broke a few of the vertical suspender-rods, and some of the small braces which connect the suspending cables; but the saddles on the top of the pyramids, which connect the centre suspending-cables with those which run to either shore, were not in the least degree disturbed. As the wind lulled the undulation subsided, and carriages, &c., immediately crossed as usual. The whole cost of the damage incurred during this severe gale, which lasted 12 hours, will not amount to more than 20*s*. or 30*s*.! To estimate, in some degree, the power of the master-mind that designed and directed the execution of a work, which could thus endure harmless such an outpouring of this destructive agent; it should be recollected that the height of these obelisks above the sea, low water, is 173 feet, that they are 552 feet asunder, and that the weight that swings between them is, at least, 650 tons, suspended at a height of 121 feet above low water. Its stability after a storm, which produced such remarkable effects, would have been matter of high exultation to its engineer if he had been living.*

STEAM BOAT PADDLES.

At the late meeting of the British Association, Mr. Price exhibited a model of a new construction of paddle wheels; he had them placed on his vessel, and could accomplish 108 miles in eight hours and a half. The paddle rose vertically and the water ran off, and it was also a saving of one-third in fuel and time. These paddle-wheels were adopted by the Ordnance.

Mr. Russel stated that in Scotland they had had great experience in steam vessels, and he would state some circumstances which were within his knowledge, and address himself particularly to the encrustation on the boiler, produced by the salt water; he had found out, when on board a steam vessel, a simple and beautiful expedient for remedying this, and it had been kept a perfect secret. He would take a boiler of a cylindrical shape; that which was most dense in the water would of course fall to the bottom, and therefore, as the cold water came in at the top the salt would descend to the bottom below the furnace, and then came the secret, there was a pipe with a stop cock, and the engineer filled the boiler a little too full, he

* Magazine of Popular Science, No. 2.

then opened the stop-cock and got off the salt. The boiler was worked for nine months, and a man was then sent into it for the purpose of clearing it out, and he found he had nothing to do for there was no encrustation. With regard to the engine, he was not one of those who expected any very great radical improvement in the construction of the steam engine; Watt, in his opinion, had left them but very little to do. In Scotland they had adopted the plan of the Cornish engine. An engine was worked on the high pressure system, and it worked expansively, and with this engine at the top of high water, with a cargo of 150 passengers, in its ordinary rate he had gone 14¾ miles an hour; the great thing to be attended to was the precise place of fixing the engine; he believed that with the ordinary boilers well made, and every thing being of the best kind, every effect they could reasonably expect would be obtained. With regard to paddle wheels, he considered those produced by Mr. Price of great value, where the engine was not properly proportioned, or where the vessel was not a good one; but he was convinced, for a long train of circumstances, that in a well-built vessel, with properly proportioned engines, the common paddle wheel was not only the simplest, the cheapest, the most secure, but was the best in theory as well as in practice.

Mr. Price maintained that the patent paddle wheel was very far superior. He had laid out 1,000*l.* in putting them to his vessel, and he had found that he could beat all the other vessels of the same size.*

BREAKWATER AT MADRAS.

MADRAS has been long well known as one of the most dangerous ports for shipping in the East. It is with no small degree of pleasure that we observe its enterprising inhabitants coming forward with liberal subscriptions, for the purpose of raising a breakwater.—*Madras Gazette, June*, 1835.

It is proposed that the work should be unconnected with the shore; that its shape should be a straight line parrallel with the coast; that it should be of rough stone; and that it should be neither within, nor much beyond, the outer line of the surf. Its distance from the shore will be about 350 yards, and its length about 200. The depth of water is about 20 feet; and as it is intended to raise it five feet above high water, its total height will be 25 feet. The materials are to be brought down the Adyar, passed over the bar in trucks, or by means of cranes; and conveyed by sea on catamarans, to the site of the work. The estimated expense of the carriage is one rupee per cubic yard, and of the quarrying 1¾ rupee; and the whole expense as follows: Quarrying, 20,400 cubic yards, at 1¾ rupees, 35,700, conveying

* Thomson's Records, No. 22.

at one rupee = 20,400, total 61,100 rupees. But as government have liberally offered to furnish prisoners, &c., to assist in the work, it is hoped that the whole of the expense of the quarrying will be saved to subscribers, leaving only 25,400 rupees to be provided. The subscriptions already amount to 40,000 rupees; leaving a large sum to cover unforeseen expenses. The whole work, it is proposed, should be similar in structure, to the Plymouth Breakwater; but, of course, it will be on a much smaller scale; that of Plymouth being in 56 feet water.*

METHOD OF TUNING A GUITAR WITHOUT THE ASSISTANCE OF THE EAR.

THIS method, proposed by M. Bary, professor of Physics, at the Royal College of Charlemange, in Paris, depends on the circumstance, that the communication of vibratory sounds is most effective through elastic media, when the bodies in the vicinity of the original vibrated body are capable of vibrating in unison with them. When, therefore, two strings fastened near each other possess, for their concord, the necessary tension and length, and one of them is made to sound, the vibrations are, with much force transferred to the other, and this transference can be made, as Saveur has shown, perceptible to the eye, by placing a saddle of paper upon the string, at first, in a state of rest. When this string *hears* the other, the saddle will be shaken, and fall off. When both strings are in harmony, the paper will be very little, or not at all shaken.†

ON THE MANUFACTURE OF POLISHED STEEL STUDS AND BEADS.

By Thomas Gill.

THESE studs and beads are employed in great quantities by the steel-workers, by the makers of steel dress sword-hilts, and in what the French term *bijouterie en acier*, or steel jewellery, of which we shall treat hereafter; they, therefore, form manufactures of considerable importance, but, we believe, they have not hitherto been described by any writer.

The best steel studs are made out of decarbonated cast steel; the commoner kinds are cut out of sheet iron, of a proper thickness, and are formed into small round or oval pieces, by beds and punches, in the screw press, in the usual and well known manner, and which, therefore, need not be described here. Each piece has, afterwards, a hole made partly through the middle of it, at its back, by means of a pointed steel punch and hammer, to receive a stem of pointed iron wire, which is driven hard into it, to retain it in its place until it is afterwards secured more

* Thomson's Records, No. 18.

† Thomson's Records, No. 14.

firmly by soldering. A number of these studs, thus prepared, are then inclosed in wetted brown or rope-paper, together with bits of brass, as solder, and a little borax, as a flux, and the whole wrapped up into a cylindrical shape; this is then covered with a crust of clay, leaving, however, a small hole at one end of it open, for a purpose to be hereafter described. It is then placed in a forge fire, gradually and carefully heated by blowing, and, at the same time, turned round a little, from time to time, until a white fume or vapour is seen to issue from the hole previously made for that purpose; this indicates that the brass is fused, the zinc becoming volatilized in its usual form, and thus escaping: the mass is then to be instantly withdrawn from the fire, and to be rolled backwards and forwards upon the ground, so as to diffuse the solder uniformly amongst the studs, whilst cooling. And here, it may be remarked, that the zinc in the brass, which rendered it more fusible, becoming thus volatilized, leaves behind it chiefly the copper with which it was combined to make brass; and it is well known, that copper forms an intimate and close union with iron, when thus heated in contact with it, and oxygen nearly excluded. When cold, the crust of clay is broken off the mass; and the studs will be found to have their stems of wire firmly soldered to them, and ready to undergo the succeeding process, viz., that of being brought to a proper shape by filing them.

The next process is that of case-hardening them; but, as it is requisite that their stems should remain soft afterwards, in order to admit of being screwed or rivetted in use, so it is necessary to prevent the action of the case-hardening materials upon them; this is effected by inclosing each stem in a slight coat of clay, and thus cutting off all access of the carbonaceous materials to them.

Animal charcoal is the material usually employed in case-hardening, by the steal-workers; this is frequently procured from the ammonia-works, after the distillation of bones, for the production of the different matters to be obtained therefrom. Charcoal is ground to a coarse powder, and put into a sheet iron or a cast-iron box; a layer of it being spread over the bottom of the box, a number of the studs are then dispersed, at equal distances apart, over that layer of charcoal; another layer of charcoal is then spread over them, and this, in its turn, receives another deposit of the studs; and so on, *stratum super stratum*, until the box is nearly filled, the uppermost layer being composed of charcoal. The box thus filled, or several of them, must then be placed in an open fire-place, filled with pit-coal, and remain exposed to a red-heat, for a sufficient time, to cause the case-hardening effect to take place, and which will depend upon the size of the articles exposed to its action, or to the depth or thickness to which it is intended to carry the hardening process; it being very desirable, frequently, to limit its action to the exterior surfaces of the arti-

cles, leaving their interior still merely soft iron, and this, in order to combine strength or toughness with great hardness, in the delicate, small, and frequently thin articles, made in steel jewellery. When the case-hardening effect is thought to be sufficiently produced, the whole contents of the box, charcoal and all, are thrown into water, or, which is better, into water the surface of which is covered with a layer of oil, two or three inches in thickness, and which is thought to prevent the liability of the articles cracking in hardening them.

Burnt leather is, by some, preferred to the charcoal of bones, for case-hardening. In order to prepare this, old shoes, or other scraps of leather, are collected, and these are burnt or scorched by being laid upon a fire of pit coal, made in some open place, away from houses, on account of the ill smell produced in the burning; the scorching is to be continued until the leather is sufficiently friable to be capable of beating into powder when become cold.

Decarbonated cast steel is preferred to iron, for delicate works in steel jewellery, where it is wished to avoid all appearance of flaws or veins in the articles made of it. This process is performed by inclosing the slips, or sheets of cast steel, in iron boxes, filled with rusty iron filings, and which are greedy of carbon, and deprive the cast steel of it; thereby reducing it to the state of the softest and purest iron, when heated to redness during several days and nights, according to the thickness of the steel: thus treated, it will not harden like steel, by merely heating and cooling, but, after forming the articles of it, they must be case-hardened, as above described.

The cutting and polishing facets, on steel studs, is performed in a nearly similar manner to those upon steel beads; and we shall, therefore, postpone the description thereof, until we have treated of the manufacture of these latter articles.

Steel beads, if very small, are cut out of thick sheet iron, or decarbonated cast steel, by means of beds and punches, in the screw-press, as in the making of steel studs, but have holes perforated entirely through them. If, however, they are of larger sizes, then they require a different treatment: being formed hollow, out of decarbonated cast steel, in the following very ingenious manner:—The steel, being cut into circular pieces, by means of beds and punches, in the screw-press, is next to be dished, or made concave, in a pair of dies, fitted concave and convex to each other, in a screw-press, until they have rims turned up around them, at an obtuse angle; these, after being well softened by annealing, are then subjected to the action of another pair of dies, by which their rims are turned up still more; they are then again annealed, and pressed between another pair of dies, which brings their rims into nearly a cylindrical shape; and then, after again annealing, they are pressed by the action of other dies into a perfectly cylindrical form. The

next process is, by means of a circular bed and punch, to cut out the entire flat piece of metal, and thus to leave a cylindrical ring only, like a ferrule; this is then placed, after being again well annealed, in a pair of concave dies in the screw-press, in an upright position; and the effect of the dies upon it is, to contract each end of the cylindrical ring a little inwardly; another pair of dies succeeds to these, which still more contract the ends,—and again another pair, and so on, observing to anneal them well between each operation: until, at length, a globular or oval hollow bead is thus made, having merely small holes in its ends, which are necessary to its use. And thus, and without any joint or seam, is a regularly shaped hollow body formed out of a plate or sheet of steel!

The facets are formed upon the surfaces of the steel studs and beads, either by filing them whilst in the soft state, and in which mode the more expensive kinds are prepared,—as well, also, as others; or, after they are hardened, by grinding upon flat pewter laps, with the assistance of coarse emery and water, in which way the more numerous and cheaper kinds are cut. The filed studs and beads being case-hardened, as well, also, as those which were cut after hardening them, are now in the state in which the marks left in them by the file, and those caused by the coarse emery, must be removed by the application of finer sifted, or washed emery, either mixed with water or oil; in the former case, by the use of hard, flat brushes, continually rubbed over them backwards and forwards, when cemented upon a broad and extended flat surface; or in the latter employment of oil and emery, by holding them against cylindrical brushes, mounted upon square spindles, conically pointed at their ends and turned in the lathe, either by the foot of the workman,—the long-wheel, as it is termed,—or in mills, on a large scale, by the powers of water or steam. When this process has been performed for a sufficient length of time, or until the coarse file or emery marks are removed, then a still finer kind of washed or flour emery must be employed, mixed with oil, and applied upon an entirely distinct brush or brushes from those used in the last operation; and this process must also be continued until the finer marks, left by the last emery employed, are likewise in their turn completely obliterated; and the articles will then be fitted to receive their ultimate black polish and lustre.

Instead of mounting the beads upon cement-blocks, they may be strung upon wires, when applying emery and oil to them; and thus save the trouble of repeatedly mounting, and again re-mounting them on the cement-block, in a different position to the former ones, in order to receive the effect of the emery over their entire surfaces.

The last finish, or polishing, can only be properly given to the steel studs or beads by employing putty, or the combined oxides of lead and tin, finely ground,—and either with water, or, which

is better, with a mixture of alcohol and water, or proof spirit, applied upon the soft skin of the palms and inner sides of the fingers of the hands of women! Nothing equal to this process having hitherto been discovered in practice, to give the steel its black polish or lustre.

Having thus generally described the processes employed in the manufacture of polished steel studs and beads, we may here remark, by the way, that the very same method of soldering with brass, employed in fixing the wire stems in the studs, is likewise used by the locksmith, in soldering the delicate wards of his locks; and also by the vice maker, who thus firmly combines the threads of the hollow screws in his vices with their surrounding boxes, and their other adjoining parts, instead of cutting them, by means of taps, out of the solid metal in the ordinary way; and yet so firmly are they thus united, that an instance of the thread of the screw stripping or quitting its place in the box, by the utmost power applied in using the vice, is a very rare occurrence, and, indeed, scarcely to be met with!*

A PLAN WHEREBY A WOODEN RAILWAY SHALL BE RENDERED AS INDESTRUCTIBLE AS THE BEST IRON RAILROAD.

This plan consists in having the excavations and embankments made sufficiently wide to admit a side ditch, or ditches, and extra embankments raised upon the outer edges of the road to an elevation of fifteen or eighteen inches above the plane of the road-way. These extra embankments should be made about one foot wide on the top, with slopes of one and a half of base to one of perpendicular rise.

The side ditch or ditches, with the extra embankments, and the upper surface of the railway, should be constructed with water-tight materials, and the ditch or ditches made with the sufficient cross section to admit a quantity of water to feed the required distance. The cross section of the ditches will be greater upon the level parts of the road than on the descending planes, and greater at the end where the water is introduced, and decreasing toward the final discharge or waste of the water.

The feeders should be admitted at convenient distances, the less the distance from one feeder to another, the less will be required for the dimensions of the ditches. Waste weirs should be built at proper points, so as to discharge all surplus water, and the feeding-gates should be regulated to give a certain quantity of water and no more, as near as the circumstances will admit.

After the wooden sleepers and rails are laid, with the iron plate put on, and the road completed for use, the water should be introduced and maintained to an elevation that will com-

* Magazine of Popular Science, No. 1.

pletely cover the rails, leaving the track about one inch under water. This will be a sufficient depth, and need not be exceeded for the purposes here required to accomplish.

It is well known that wood immersed completely under water is thereby prevented from decay; hence a wooden railroad in the situation here described would last as long as the best constructed iron road.

The difference in cost of course would be different, as the circumstance and character of the ground would change; but I have no doubt but the average cost of railroad, upon this plan, would be 5,000 dollars per mile less than the double track iron road.

There is hardly any situation where railroads of any extent are made, but streams of water sufficient for the purposes required can easily be obtained. In the winter season the water should be drawn off or reduced at least two inches below the top of the rail. There is but little tendency to decomposition during the frosty weather, hence but little objection can be urged against this measure.

The slight obstruction the water would be to the rapid progress of the engine and cars would be nearly balanced by having a constant, clean and uniform surface for the wheels to run upon, the friction would be more equal, consequently the moving power could be better regulated.

A thin, light, wooden box should be made to inclose the wheels from near their bearing surface over the top, in order to prevent the centrifugal force of the wheels in motion from throwing the water over the bodies of the engine, cars, &c.

Many advantages might be enumerated in favour of this plan of making railroads. One is the uniformity which would be given to the temperature of iron plate, thereby correcting in a manner one of the great evils, the contraction and expansion of the iron plate. I believe, also, where a road should be made in this manner, and well settled, there would not be half the liability to derangement. It is the alternate wetting and drying causing the contraction and expansion of materials, which eventually disorganizes the road.*

GRADIENTS ON RAILWAYS.

On May 19, a paper was read before the Royal Society, entitled "On the valuation of the mechanical effect of Gradients on a line of Railroad," by Peter Barlow, Esq., F.R.S.

The exact amount of the influence of ascents and descents occurring in the line of a railway on the motion of a load drawn by a locomotive engine having been differently estimated by dif-

*"American Railroad Journal, quoted in the Mechanics' Magazine, No. 691.

ferent persons, the author was induced to investigate the subject. A few observations are premised on the erroneous assumptions which, he conceives, have in general vitiated the results hitherto deduced. The first of these is, that the expenditure of power requisite for motion is equal to the resistance to traction; whereas it must always greatly exceed it. No account, he remarks, has been taken of the pressure of the atmosphere on the piston, which the force of the steam has to overcome before it can be available as a moving power. Another source of error has been, that the statical and dynamical effects of friction have been confounded together; whereas they are the same in amount only when the body is put in motion by gravity; but not when it is urged down an inclined plane by an extraneous force. In the latter case these effects are no longer comparable; friction being a force which, in an infinitely small time, is proportional to the velocity, while that of gravity is constant at all velocities; or, in other words, the retardation from friction is proportional to the space described, while that from gravity has reference only to the time of acting, whatever space the body may pass over in that time. It is an error to assume that the mechanical power of the plane is equivalent to a reduction of so much friction; for the friction down the inclined plane is the same as on a horizontal plane of the same length, rejecting the trifling difference of pressure; and the whole retardation in passing over the plane, or the whole force required to overcome it, is the same at all velocities, and by whatever force the motion is produced; but the assisting force from gravity is quite independent of the space or of the velocity.

In the investigations which the author has prosecuted in this paper, he assumes that equal quantities of steam are produced in the same time at all velocities; and he adopts for his other data, those given by Mr. Pambour in his *Treatise on Locomotive Engines.* He deduces a formula from which, the speed on a level being given, we may compute the relative and absolute times of a train ascending a plane; and, consequently, also the ratio of the forces expended in the two cases; or the length of an equivalent horizontal plane; that is, of one which will require the same time and power to be passed over by the locomotive engine as the ascending plane.

The next objects of inquiry relate to the descent of trains on an inclined plane, and comprise two cases: the first, that when the power of the engine is continued without abatement; and the second, that when the steam is wholly excluded, and the train is urged in its descent by gravity alone. The author arrives at the conclusions, that, in the first of these cases, when the declivity is one in 139, the velocity, on becoming uniform, will be double that in a horizontal plane: and that for a declivity of one in 695, the uniform velocity of descent will be one-

fifth greater than on the horizontal plane; and this, he observes, is perhaps the greatest additional velocity which it would be prudent to admit. A plane of one in 695 is, therefore, the steepest declivity that ought to be descended with the steam-valve fully open; all planes with a declivity between this and that of one in 139, require to have the admission of steam regulated so as to modify the speed, and adjust it to considerations of safety; and lastly, all planes of a greater slope than this last require, in descending them, the application of the brake.*

WORK DONE BY THE TEN BEST ENGINES OF THE LIVERPOOL AND MANCHESTER RAILWAY, DURING THE YEARS 1831, 1832, 1833, AND THE TWELVE FIRST WEEKS OF 1834.

THIS statement shows what can be expected from locomotive engines, when constructed with care and of good materials; and there is no doubt that, in time, more work will still be obtained from them.

Year.	Name of the Engine.	Total Distance travelled by the Engine.	Total Time the Engine has been on the Road, either in Activity or in Repair
1831.	Mercury	23,212	52
	Jupiter	22,528	44
	Planet	20,404	52
	Saturn	19,510	38
	Mars	18,645	50
	Majestic	18,253	52
	North Star	15,677	52
	Northumbrian	15,607	52
	Phœnix	15,405	52
	Sun	13,434	37
	Sum	182,675	481
	Average per week ..	380	
1832.	Vulcan	26,053	52
	Liver	22,651	43
	Venus	20,464	52
	Etna	20,399	52
	Saturn	20,312	52
	Vesta	17,739	52
	Victory	17,082	52
	Planet	16,885	52
	Sun	16,535	52
	Fury	15,603	52
	Sum	193,723	511
	Average per week ..	379	

* Philosophical Magazine, No. 55.

Year.	Name of the Engine.	Total Distance travelled by the Engine.	Total Time the Engine has been on the Road, either in Activity or in Repair.
1833.	Jupiter	31,582	52
	Ajax	26,163	52
	Firefly	24,879	39
	Liver	23,134	52
	Pluto	20,308	52
	Vesta	19,838	52
	Leeds	19,364	48
	Saturn	18,738	52
	Venus	18,348	52
	Etna	17,763	52
	Sum	220,117	503
	Average per week ..	438	
1834.	Firefly	8,542	12
	Vulcan	8,526	12
	Saturn	7,290	12
	Liver	7,080	12
	Sun	7,080	12
	Etna	6.557	12
	Leeds	5,712	12
	Ajax	4,890	12
	Venus	4,632	12
	Pluto	4,246	12
	Sum	64,555	120
	Average per week ..	538	

Among those engines, the Liver had worked for 107 weeks, had travelled 52,865 miles, or, on an average, 494 miles a week during all that time; the Firefly had worked 57 weeks, had travelled a distance of 33,421 miles, or 586 miles per week; and neither of these engines, at the period in question, had yet required a fundamental repair.* †

DESCRIPTION OF AN IRON SUSPENSION BRIDGE CONSTRUCTED OVER THE BEOSE RIVER, NEAR SAGAR, CENTRAL INDIA, BY MAJOR PRESGRAVE.

The bridge was erected at the suggestion of T. H. Maddock, Esq., Agent to the Governor-General in the Ságar and Narbada

* The greater part of these excellent engines were built by R. Stephenson, so well known for his important and numerous improvements in this branch of industry.

The Liver engine, the merit of which is sufficiently established by the above-stated facts, is the work of Messrs. Edward Bury and Kennedie, of Liverpool.

† From Pambour on Locomotion, quoted in the Mechanics' Magazine, No. 677.

territories, upon the plans, and under the sole superintendence, of Major Duncan Presgrave, Mint and Assay Master at Sagar.

Engineers in Europe, accustomed to find every thing provided for their wants, can have little idea of the personal labour which devolves upon their brethren of the craft in this country, where to the duties of architect and draftsmen are not only added those of builder and overseer, but the whole of the subordinate trades of the brick-maker, carpenter, mason, and iron-manufacturer; in a climate, too, where little exertion produces exhaustion, and incautious exposure, fever or death, and where the tools must be made, and the hands that employ them instructed *ab initio*. We will not say that the native *mistrees* and labourers are not capable of learning or of working well, especially in Upper Hindustan; the bridge before us is a sufficient refutation of that common and *indolent* remark; but all will agree that a peculiar talent is necessary to manage, instruct and drill them; and this faculty is possessed by Major Presgrave in an extraordinary degree. The secret of his influence may be easily traced—he is a workman himself; he wields the hammer; makes and works the lathe; surveys the ground; searches the mines; smelts the ore; and has all the skill of contriving with the simplest means, for which the people of this country are themselves so conspicuous.

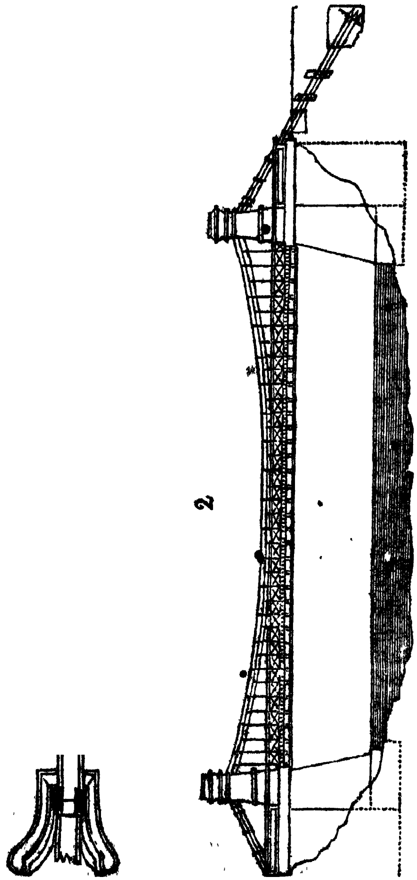
The Ságar Bridge may indeed be called an experiment to try the resources of the country; to see whether the iron could be manufactured into bars of a quality fit for bridges; and whether these bridges could be made by native workmen who had never wrought or even seen iron of the dimensions required. The question has been satisfactorily answered; and even in point of economy, notwithstanding the numberless extra expenses incident to a first undertaking, and the distance, eleven miles, of the work from the yard at Ságar; the bridge has been pronounced cheaper than those on Calcutta, made with English materials; while of its design and execution no higher encomium can be given than the assurance of the visiting engineer, Major Irving, that he had seen nothing superior to it in Europe.

The foundation was laid in April, 1828, and the roadway opened to the public in June, 1830. The iron of which it is composed is entirely the produce of the Ságar district. When the bridge was projected, it was still in the state of ore in the mines, whence it was extracted, smelted, and made into irregular small lumps, in the common native fashion. The working of the crude, impure masses into good bars of the requisite dimensions, was a matter of very great labour and difficulty. The bridge is 200 feet in span between the points of suspension.

The piers, resting on the solid rock, 6 feet under the land level of the river, are 42 feet high to the roadway; being elevated 2 feet above the ordinary surface of the country. They have a base of 32 feet by 22, decreasing upwards in front 1 in 5, for the sides one in 8 feet; which gives on the road a superficies of 21 by 14

feet for each pier. On the sides are wing walls or abutments running back into the bank 26 feet.

The pillars, or rather arches, of suspension, have a base of 21 by 12 feet, admitting a roadway of 9 feet broad. The arches are 15 feet high, and are faced with accurately wrought stone. The



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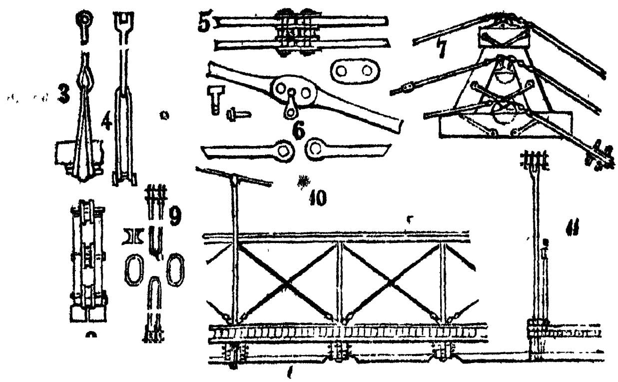
(Iron Suspension Bridge in Central India.)

points of suspension are elevated 22 feet 4½ inches from the road. The pillars have a total height of 33 feet, and the whole masonry from the rock 58 feet. The piers and abutments contain 82,488 cubic feet of masonry; the arched standards and bridge parapets 8,900; in all 91,388.

The platform measures 200 feet in length by 12 feet broad, and is calculated to weigh, with the chains, 52¼ tons. Supposing the bridge crowded with men, at 69 lbs. per superficial foot all over the platform, the whole weight would be 120 tons: whence it is calculated that the tension to be sustained at each point of suspension would be 85,632 tons.

The suspending chains are twelve in number, arranged in pairs, three pairs on either side, two feet above one another. They pass over rollers 1 foot in diameter, and are securely moored in masonry 16 feet below the surface of the road. The back chains are 101 feet long, rising at an angle of 27 degrees. The angle of the catenarian is 16 degrees with the horizon; the versed sine at the centre of the curve is 14 feet 3 inches.



The twelve main chains are of round bar-iron, one and a half inch diameter, bolted together in pairs; they are from 15 to 15·5 feet long, and so arranged, that the vertical rods may fall from the joints of each chain alternately in parrallel lines 5 feet apart. The descending chains are square, measuring 1¾ inch on the side; their lower ends pass through 24 conically wrought stones, below which they are capped and keyed, (figs. 1 and 2.)

The connecting links of the chains, and indeed all the bolt-holes in the bars and the drops, are bored out of the solid iron, and broached to fit the bolts accurately, (figs 5 and 6.) None were punched at the forge. The bolts are 1¼ inch in diameter, and are secured by rings, or washers and keys. Two adjusting links, with iron wedges, are fitted to each chain, close to the masonry, to regulate its curve and dip, (figs. 7 and 9.)

The method of constructing the rollers is thus described:—

"The iron rollers, twelve in number, weigh about 1 cwt. each. They are not solid, but are composed each of about 28 separate pieces of wrought-iron, viz. a centre tube or box for the axle, over which thick

rings are driven; and an exterior drum, between which and the inner-ringed tube, flattened bars as spokes are driven. The centres are broached out clean and true; and cylindrical axles, 3·1 inch in diameter, were turned to fit: the ends of these axles rest on broad, thick iron bearings, mounted in very strong, solid frames of timber, well bolted, clamped, and blocked together; covered with pitch cement, and secured in the masonry of the pillars." (Figs. 7 and 8.)

The platform was made in a different method from those of our Calcutta bridges, as will be understood by the following explanation:—

"From the short links set between the centre plates of the shackles (of the main chains,) are suspended alternately from ties, 74 vertical round rods, 1 inch in diameter, connected to a short link, (fig.6,) by a 1-inch round bolt passing through it, and the socket at the upper end of the bar; at their lower ends the rods have eyes, through which doubled loops of iron pass, (3 and 4,) for sustaining the flat bars or girders, set on their edges, and proceeding from one end to the other on both sides of the bridge.

"The flat bars, 4 inches broad by ¾ inch thick, and in lengths of 15 feet, are joined at their ends by nicely turned bolts, passing through bored holes 2 inches in diameter; they are adjusted in their height by double wedges resting on holders that connect the sides of the loops together. The girders are also adjustable in their lengths; the bars that enter the masonry have their ends made broader than the rest of the bars, in which are long openings 2 inches broad to receive wedges. (figs. 10 and 11.)

"Eight timbers in an upright position are set in the masonry of the pillars, having upright grooves or spaces cut through them, and faced with thick plates of iron; through two of these beams each end bar passes, and may be wedged on either side of the timber towards the land, as occasion may require: thus is the whole length of girder drawn more or less to either end of the bridge, and also rendered exceedingly tight and steady. The grooves in the timbers towards the river, being about four inches longer than the breadth of the bars, permit them to adapt themselves to their proper directions when drawn lengthwise, by the wedges acting against the landward beams; by this means the bars have sufficient play to adapt themselves to the motion of the platform, and all jirks at the pillar obviated.

"Thirty-seven double joists, 12 feet long, are, (having their ends notched below for the purpose,) laid on the girders; their centres, 5 feet apart, correspond exactly with the vertical rods that pass through them; the joists are composed each of two cheeks, a foot in depth and 3 inches thick, separated at intervals by four blocks of wood of the same height and thickness, all firmly put together with bolts, screws, and nuts: two cleats are nailed to each end of the joist on their under sides, whose ends fit flat against the girder and keep all steady.

"Planks, 16 feet in length, running longitudinally, each plank stretching over three paces, and regularly disposed as to their joints, are spiked down on the joists: in a direction across these, and upon them other planks are spiked down, their lengths being the same as the breadth of the platform. The planks are all embedded in a composition of resin boiled in linseed oil, which in laying on is mixed with ashes. The lower planks are 3 and the upper ones 3½ inches thick; they are only 6 inches broad to prevent warping, and have two strong square-headed spikes passing through them near their edges at every crossing of the upper over

the lower planks; their joints are clinched below the platform, to accomplish which 16,370 spikes weighing a ton and a half were used; thus the platform has been rendered extremely strong and firm.

"The better to secure the sides of the platform and ends of the timbers from the weather, a cornice or moulding of wood is nailed along the outside.

"The hand rail is trussed, and consists of iron pillars or stanchions; diagonal braces of iron, and a stout wooden rail running from end to end of the platform: the whole put together with screws and nuts, and adjusting screws for setting up or tightening the diagonal braces whenever required. (Fig.10.)

"The rise in the platform is as before stated, 9 inches, but the curve of the hand-rail is only 3 inches; to effect which, the stanchions which support the rail are of varying lengths, the rail being 4 feet 6 inches above the platform at its connexion with the masonry, but only 4 feet in the centre of the bridge."

The following are the weights of the chains, rods, and materials of the platform:

	Iron. Tons.	Wood. Tons.	Tons.
Six double main chains, joists, and bolts .	8·5		
74 vertical rods with joints, bolts, &c. ..	1·385		
Flat bars and bolts	1·726		
37 double joists, blocks, cleats, &c. ..		6·190	
Bolts, nuts, screws, stanchion plates, flat rings, &c. &c. from beams	0·383		
Planking 1,124 cubic feet sal wood ..		27,000	
Iron spikes 16,370, for planking	1·467		
Iron railing trussed, screws, nuts, &c. ..	1·314		
Wood for the hand-rail, 52 cubic feet ..		1·479	
376 feet of cornice to the platform		1·531	
Composition of resin and oil	14,775	36,200	50,976
Total weight hung between pillars ..			1,745
		Tons ..	52,721*

THEORY OF RAILWAYS.

On April 28th was read, before the Royal Society, a paper on certain parts of the Theory of Railways; with an investigation of the formulæ necessary for the determination of the resistances to the motion of carriages upon them, and of the power necessary to work them. By the Rev. Dionysius Lardner, LL.D., F.R.S.

The author observes, in his prefatory remarks, that an extensive and interesting field of mathematical investigation has been recently opened in the mechanical circumstances relative to the motion of heavy bodies on railways; and having collected a body of experiments and observations sufficient to form the basis of a theory, he purposes, in the present paper, to lay before the Soci-

* Journal of the Asiatic Society, quoted in the Mechanics' Magazine, No. 664.

ety a series of mathematical formulæ, embodying the most general expressions for the phenomena of the motion of carriages on these roads.

The author begins by investigating the analytical formulæ for the traction of trains over a level line which is perfectly straight, and finds, first, the distance and time within which, with a given amount of tractive power, the requisite speed may be obtained at starting; and also the point where the tractive power must be suspended, previous to coming to rest. The excess of tractive power necessary to get up the requisite speed is shown to be equal to the saving of tractive power previous to a stoppage; and formulæ are given for the determination of the time lost under any given conditions at each stop.

The motion of trains in ascending inclined planes which are straight, is next considered; and formulæ are given combining the effects of friction and gravity, in opposition to the tractive force. The circumstances which affect every change of speed, and the excess of tractive force necessary, in such cases, to maintain the requisite speed, are determined; as well as the other circumstances already stated with respect to level planes.

The friction of trains upon descending planes is next investigated; and an important distinction is shown to exist between two classes of planes; viz., those whose acclivities are inferior to the angle of repose, and those of more steep acclivities. A remarkable relation is shown to exist between the tractive forces in ascending and descending the first class of planes. For descending planes of greater acclivity than the angle of repose, the use of breakes becomes essentially requisite. The effect of these contrivances is investigated, as well as the motion of trains on the accidental failure of breaks.

In any attempts which have been hitherto made to obtain the actual velocities acquired by trains of carriages or wagons under these circumstances, an error has been committed which invalidates the precision of the results: the carriages having been treated as sledges moving down an inclined plane. The author has here given the analytical formulæ by which the effect of the rotatory motion of the wheels may be brought into computation; this effect, depending obviously on the amount of inertia of the wheels, and on the proportion which their weight bears to the weight of the wagon.

The properties investigated in this first division of the paper, are strictly those which depend on the longitudinal section of the line, presumed to be straight in every part of its direction. There is, however, another class of important resistances which depend on the ground-plan of the road, and these the author next proceeds to determine.

The author then gives the analytical formulæ which express the resistance arising:—first, from the inequality of the spaces over which the wheels, fixed on the same axle, simultaneously

move; secondly, from the effort of the flanges of the wheels to change the direction of the train; and thirdly, from the centrifugal force pressing the flange against the side of the rail. He also gives the formulæ necessary to determine, in each case, the actual amount o pressure produced by a given velocity and a given load, and investigates the extent to which these resistances may be modified by laying the outer rail of the curve higher than the inner. He assigns a formula for the determination of the height which must be given to the outer rail, in order to remove as far as possible all retardation from these causes: which formula is a function of the speed of the train, the radius of the curve, and the distance between the rails.

In the latter part of the paper, the author investigates the method of estimating the actual amount of mechanical power necessary to work a railway, the longitudinal section and ground-plan of which are given. In the course of this investigation he arrives at several conclusions, which, though unexpected, are such as necessarily arise out of the mechanical conditions of the inquiry. The first of these is, that all straight inclined planes of a less acclivity than the angle of repose, may be mechanically considered equivalent to a level, provided the tractive power is one which is capable of increasing and diminishing its energy, within given limits, without loss of effect. It appears, however, that this condition does not extend to planes of greater acclivities than the angle of repose; because the excess of power required in their ascent is greater than all the power that could be saved in their descent; unless the effect of accelerated motion in giving momentum to the train could properly be taken into account. In practice, however, this acceleration cannot be permitted; and the uniformity of the motion of the trains in descending such acclivities must be preserved by the operation of the break. Such planes are therefore, in practice, always attended with a direct loss of power.

In the investigation of the formulæ expressive of the actual amount of mechanical power absorbed in passing round a curve, it is found that this amount of power is altogether independent of the radius of the curve, and depends only on the value of the angle by which the direction of the line on the ground-plan is changed. This result, which was likewise unexpected, is nevertheless a sufficiently obvious consequence of the mechanical conditions of the question. If a given change of direction in the road be made by a curve of large radius, the length of the curve will be proportionably great; and although the intensity of the resistance to the tractive power, at any point of the curve, will be small in the same proportion as the radius is great, yet the space through which that resistance acts will be great in proportion to the radius: these two effects counteract each other; and the result is, that the total absorption of power is the same. On the other hand, if the turn be made by a curve of short radius, the

curve itself will be proportionately short; but the intensity of the resistance will be proportionately great. In this case, a great resistance acts through a short space, and produces an absorption of power to the same extent as before.

In conclusion, the author arrives at one general and comprehensive formula for the actual amount of mechanical power necessary to work the line in both directions; involving terms expressive, first, of the ordinary friction of the road; secondly, of the effect of inclined planes, or *gradients*, as they have been latterly called; and, thirdly, of the effect of curves involving changes of direction of the road, the velocity of the transit, and the distance between the rails; but, for the reason already stated not comprising the radii of the curves.

Although the radii of the curves do not form a constant element of the estimate of the mechanical power necessary to work the road, nevertheless they are of material consequence, as far as regards the safety of the transit. Although a short curve with a great resistance may be moved over with the same expenditure of mechanical power as a long curve with a long radius, yet, owing to the intensity of the pressure of the flange against the rail, the danger of the trains running off the road is increased: hence, although sharp curves cannot be objected to on the score of loss of power, they are yet highly objectionable on the score of danger.

In the present paper, the author has confined himself to the analytical formulæ expressing various mechanical effects of the most general kind; the coefficients and constants being expressed merely by algebraical symbols: but he states that he has made an extensive series of experiments within the last few years, and has also procured the results of experiments made by others, with a view to determine the mean values of the various constants in the formulæ investigated in this paper. He has also, with the same view, made numerous observations in the ordinary course of transit on railways; and he announces his intention of soon laying before the Society, in another paper, the details of these experiments, and the determination of the mean values of these various constants, without which the present investigation would be attended with little practical knowledge.*

STEAM NAVIGATION TO AMERICA.

Assuredly, between no countries in the world is a regular, efficient, and speedy communication, more desirable than between Great Britain and the United States of America. The numbers and respectability of the emigrants and passengers, who annually leave our shores for those of the Western hemisphere, and the vast extent of the commercial intercourse existing between the

* Philosophical Magazine, No. 55.

two countries, demanded the substitution of a more safe and certain mode of transit than that afforded by the sailing vessel, if such be practicable. Of this there seems to be little doubt; and the time is believed to have arrived for accomplishing it, and by steam navigation. Within the last few years, steam navigation has extended to the Baltic, the Euxine, the Red Sea, and the Mediterranean. A visit to St Petersberg or Constantinople, to Alexandria or Jerusalem, is now talked of, as a tour to the Rhine, or a visit to Rome, was formerly. To extend the same facilities of communication to the new world, is, as Dr. Lardner expresses it, "one of the grandest projects that ever occupied the mind of man."

Opinions, however, differ widely on the best means of accomplishing this grand project. The British and American Steam Navigation Company seem to anticipate no difficulty in going direct from London and Portsmouth to New York, while Dr. Lardner asserts, that to go to New York direct is as difficult as to go to the Moon, but sees no difficulty in the voyage between Valentia and St. John's. The Knight of Kerry, too, and his coadjutors, think it of vital importance to the whole scheme, that Valentia, and Valentia only, should be the port of arrival and departure. They seem to be of opinion, that no man can see too much of the green isle, and would not, for the world, that a passenger should embark at Limerick, maintaining, that nature never intended the Shannon for steam navigation, and they will have St. George's Channel connected with the Atlantic by a railway, running, nearly one-half its length, parrallel to the most navigable river in the kingdom.

Now, let us analyze these opposite methods of attaining the same end, for the object is the same—viz, a line of steam communication to and from New York, the centre of the wealth and intelligence, the head quarters of the enterprise and commerce, the focus to and from which tend all lines of communication—the capital, in fact, of the Western hemisphere.

The progress of steam navigation, within the last few years, is familiar to all, and has far outstripped the most sanguine expectations of its first projectors. The facility with which voyages to and from the Peninsula and Mediterranean are made by vessels, originally used in the coasting trade, until supplanted there by more powerful and efficient vessels, present the natural inference, that, by enlarging the size and increasing the power, the limits of steam navigation may be extended till they embrace the circumference of the globe, conveying the manners and manufactures of our country to the uttermost ends of the earth. We are aware that we do not agree with Dr. Lardner in this, as he asserts that any proposed voyage, which may extend beyond fifteen days, is "chimerical;" but we cannot shut our eyes to the fact, that ten years ago, it would have been "chimerical" to talk of a voyage from Falmouth to Malta in ten, or from Bombay to Seuz

in twenty-one days; to place any limit, then, (after the experience of the last few years,) to steam navigation, appears to us to savour, at least, of inexperience.

We will first state the route by which it is proposed to convey passengers from London to New York, taking these cities as the centres of their respective countries, and begin with the proposed line, *via* Valentia, advocated by Dr. Lardner. It is composed of several stages. From London to Liverpool, by railway, 200 miles; from Liverpool to Dublin, by steam packets, 130 miles; from Dublin to Valentia, by railway, 200 miles; from Valentia to St. John's, Newfoundland, 1,900 miles; from thence to Halifax, Nova Scotia, 550 miles; thence to New York, 700 miles. On the other hand, the British and American Steam Navigation Company propose, in their prospectus, to take the passenger on board at London or Portsmouth, and land him at New York. In the one instance, therefore, the passenger would change his conveyance at least four times; in the other, he would step on board and be landed at his destination.

There can be no doubt about the practicability of the route by Valentia, when the Liverpool railway is completed, and the Valentia one in operation; but some, and we confess ourselves among the number, may doubt its convenience, in comparison with the direct line, and, if that can be established, we suspect the public will prefer it, on the grounds of comfort, economy, and dispatch.

In endeavouring to prove the practicability of a line of steam packets, direct to and from the commercial centres of both countries, we must reason from analogy; and, we think, it will not be difficult to prove, that, if a voyage of 2,000 miles can be made in ten, a voyage of 3,000 miles may be made in fifteen days.

The steam vessels at present employed by His Majesty's Government, in conveying the mail to Gibraltar, Malta, and Alexandria, are considered, by many, as on too small a scale for the efficient performance of the voyage, few of them exceeding 300 tons capacity; their average speed is 170 miles per day; by the steam frigate Medea, the only one of a suitable size that has made the voyage between Falmouth and Malta, averaged upwards of 200 miles per day; and there is no doubt that, if the Mediterranean packets were increased to the size of the Medea, with a proper proportion of power, their average speed would be equal to, if it did not exceed, hers. We know, indeed, that many private vessels exceed it; that it would be easy for the government, at this moment, to contract for vessels to carry the mails, guaranteed to maintain an average speed of ten miles per hour the year round; and we see no reason why an average speed of 200 miles per day cannot be effected on the Atlantic, if it can be in the Bay of Biscay, particularly as the vessel would be much larger, and, of course, in proportion to her power, more easily propelled.

The question then resolves itself into the practicability of constructing a vessel of sufficient capacity to carry passengers, goods, stores, and fuel, a distance of 3,000 miles; and, we think, a vessel of 1,200 tons, as proposed, and 300 horse power, would have that capacity in the following proportions:—

Weight of machinery	300 tons
Weight of coals	600 ditto
Weight of passengers	100 ditto
Weight of goods	200 ditto
	1,200 tons

Taking the consumption of fuel at 30 tons per day, of Newcastle coal, or 25 tons of the best Welsh, it gives a total consumption respectively of 450 and 375 tons for a distance of 3,000 miles. As steam vessels can never compete with sailing vessels in the freight of dead weight, none but the finer descriptions of goods would be shipped by them, of which such vessels would carry 500 or 600 measurement tons.

If we are correct in these calculations, there is nothing "chimerical" in proposing to make the voyage to New York direct; indeed, it appears to us, that nothing more is necessary than to enlarge the vessels and machinery we have at present in use.

The probability of the Valentia Railway being carried into execution, is, to say the least, doubtful. Let any disinterested person examine the map of Ireland, and he will see, at a glance, that, whatever advantages Valentia may possess, for sailing packets, (and until an instance is adduced of a square-rigged vessel beating out against a westerly gale, even those may be doubted,) it has none for steam vessels. If, indeed, Ireland is to be the point of departure and arrival, it appears to us, that the port of Limerick would be the better station. The navigation of the Shannon is open; wet docks, on a large scale, are constructing there, and it would afford all the facilities of an old-established port; by its noble river it has water-carriage to Lough Allen, and, by the Royal and Grand Canals, with St. George's Channel.

We, however, wish both schemes all manner of success; there is, in our opinion, abundance of room and of employment for both. Ireland alone will support a line of steam packets to America; and we may venture to prophesy that, before 1846, either by one route or both, a voyage across the Atlantic, and a visit to Niagara Falls, will be as common as a visit to Rome and Vienna.*

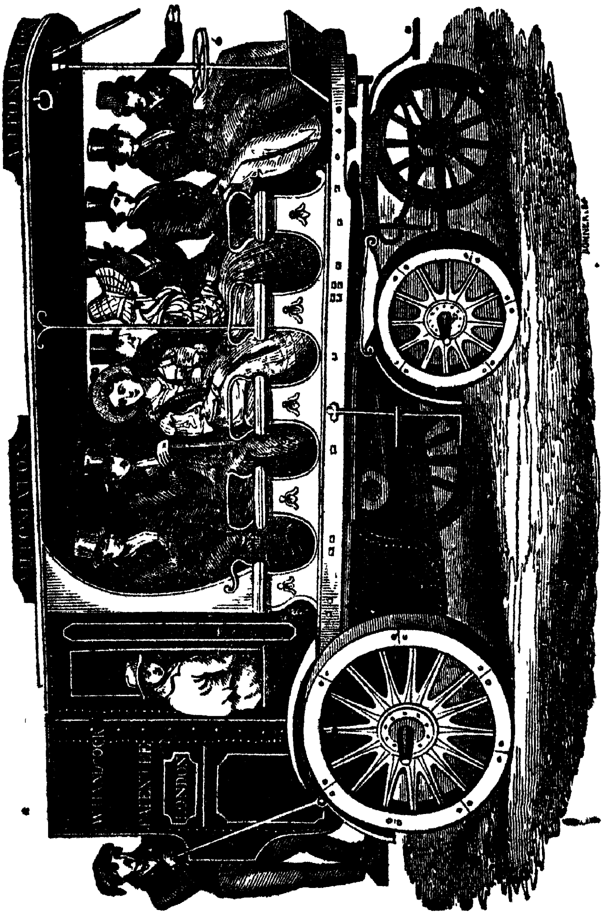
MR. HANCOCK'S LAST NEW STEAM CARRIAGE "AUTOMATON."

"MR. HANCOCK," it has been justly remarked, "is now the only engineer with a steam-carriage on any road. Sir Charles

* Athenæum, No. 429.

Dance, Colonel Maceroni, Dr. Church, Messrs. Ogle, Summers, Squire, Russell, Redmond, Heaton, Maudsley, Frazer, and a host of others—where are they? Echo answers, 'Where?'"*

In a letter to the *Mechanics' Magazine*, the inventor states



(Hancock's Steam Carriage, "Automaton.")

the difference between this and his previous carriages, to be in the engines of the Automaton being of greater power, having cylinders of twelve inches diameter, whilst those of the others are nine inches: the Automaton is also of larger dimensions

* In the Mechanics' Magazine.

than its predecessors, it having seats for 22, while they are only calculated for 14 passengers. It is an open carriage; it has carried 30 passengers at once, and had then surplus power to draw an omnibus or other carriage, containing 18 more passengers, without any material diminution of speed. Its general rate of travelling is from 12 to 15 miles per hour: on one occasion, when put upon the top of its speed, and loaded with 20 full-grown persons, it performed a mile on the Bow road, at the rate of 21 miles per hour. On the day of proving, or first starting this carriage, in July last, it conveyed a party to Romford and back, at the rate of 10 or 12 miles an hour, without the least interruption or deviation in its working.

Mr. Hancock then gives the following return of the actual work done by his steam-carriages, on the public roads and streets of the metropolis during five months:—

The miles run, about	4,200
Passengers carried	12,761
Trips: City to Islington and back	525
Paddington	143
Stratford	44
Supposing the Carriage had always been full, the Passengers conveyed would have been	20,420

Average time the Carriage has run each day: 5 hours 17½ minutes.

This carriage has gone through the City several times; and in one of the morning trips from Stratford to the Bank, it became entangled with a wagon at Aldgate, this being the only accident worth recording.

There have been consumed in the above-mentioned traffic, 55 chaldrons of coke, which are equal to 76 miles per chaldron, or about 2¼*d.* per mile for fuel; but this, on long journeys, would be much reduced, by the application of the movable fire-place, patented by Mr. Hancock; for his greatest expenditure of coke, in these short journeys, is in lowering and again raising the fire.

Mr. Hancock concludes his letter by observing: "Years of practice have now put all doubts of the economy, safety, and superiority of steam travelling on common roads at rest, when compared with horse travelling; and I have now in preparation calculations founded upon actual practice, which, when published, will prove that steam locomotion on common roads is not unworthy the attention of the capitalist, though the reverse has been disseminated rather widely of late by parties who do not desire that this branch of improvement should prosper against the interests of themselves."*

THE LONDON AND GREENWICH RAILWAY.

The London and Greenwich Railway Company was incorporated by Act of Parliament in 1833, and the capital which it was

* Abridged from the Mirror, No. 811.

announced would be sufficient to complete the work was estimated at 400,000*l.*, or twenty thousand shares at 20*l.* each; the whole of which shares were speedily disposed of. The projector of the undertaking was Lieutenant Colonel Landmann, who has become the principal engineer; and the architect chosen was Mr. M'Intosh. The first stone was laid April 4th, 1834.

It may be here necessary to state, that the Company had the power to borrow 133,000*l.*, in addition to the 400,000*l.* raised by shares, of which power they have availed themselves; but, it ought to be added, according to the evidence of Mr. George Walter, the resident Director, that the Company have for this sum, about forty acres of freehold frontages, on each side of the Railway, which have been valued at 112,900*l.*

The Railway commences close to Tooley-street, and from thence runs upon brick arches in a straight line to the High-street, Deptford—to which place it is at present only completed; thence it will be continued with a gentle curve across the Ravensborne river to its terminus, about 200 yards from the church at Greenwich. A considerable number of arches have been continued close to the edge of Deptford Creek, in which two substantial piers have been erected, and over these an iron arch will be thrown. The arches which will extend to nearly a thousand in number, are built in the most substantial manner upon concrete foundations. So rapidly have some of them been built, that 422 reared their heads within the first year.* The arches, each 18 feet span, 22 feet high, and 25 feet in width, support a viaduct, upon which is laid the railway, being 25 feet wide, with 22 feet in the clear—that is to say, between parapets, which run from end to end, full breast high, so as to prevent accidents. These parapets

* Mr. Herapath, by no means a partisan of the Railway Company, bears the following testimony to the excellent construction of the arches, in the Mechanics' Magazine:—"In so short a distance as four miles, great differences in the under soil were hardly to be expected. However, substrata of clay, gravel, sand, peat, bog, and floating-land, seem to have presented themselves in luxuriant variety, the best soil often in juxtaposition with the worst. But with these, the engineer has successfully contended, so that it would require a professional eye to discover any effect of settlement out of 575 arches already built. In general, the arches are segments of circles; but almost every species of arch in use, except the Gothic, is pressed into service as circumstances need. The eye is occasionally arrested by an arch commencing with the segment of a circle, and when looked through, presenting a parabola or part of an ellipse. Professional men well know the difficulties of such oblique structures, yet, as far as I could perceive, there is no deficiency of symmetry or regularity, while the transition of figures seized the mind with its pleasing effects. The prevailing character of the work may be summed up in uniform neatness and strength without heaviness. For the purpose of additional security, cross walls are built between the arches, over which the rails are to lie for the trains, and the intervals are filled with concrete. By this means, the mass is rendered one solid piece, and the weight of the carriages is spread over a large space.

are two feet thick of solid brick-work: at given distances there are small boxes for the signal-men, and those whose duty it is to keep the rails clear, and give notice of any cause which may arise for stoppages. Although the elevation of the viaduct from the ground is 22 feet, from the strength of the parapets, (a precaution, by the by, not adopted in some of the most elevated parts of the Manchester Railway,) the possibility of being thrown off in the event of accident is prevented. The whole length from London to Greenwich, will be rather more than three miles and a quarter, so that the actual distance saved will be a mile and three quarters. The construction on arches was rendered necessary by the number of streets over which the line must be carried, and with the traffic through which it would otherwise have greatly interfered. At present, there are but two lines of rails, which are of malleable iron, of greater thickness than any previously used. These rails are fastened on ponderous blocks of granite, one foot apart, in so secure a manner as to preclude the chance of their being displaced; while the line is lit from end to end with gas, for the more certain supply of which extensive gas-works are now erecting by the Company, close to Deptford Creek. In order to avoid those casualties which have so frequently occurred on other railways by the indiscriminate admission of strangers, no person whatever is allowed on the Greenwich Railway, save those in the travelling-carriages, or those immediately connected with the works, whose experience enables them to avoid danger; and this is effected by the entrances being strictly guarded by the police of the Company. The total number of arches completed to Deptford is 842, in which it is calculated that upwards of sixty millions of bricks have been consumed. The iron rails weigh 50 lbs. per yard, besides the chairs or sleepers by which they are fixed, which weigh 20 lbs. each, so that the enormous quantity of iron consumed may be easily ascertained.

The arches, from end to end, are capable of being applied to various useful purposes: some have already been taken as stables and warehouses, others as shops; several at the Deptford end are appropriated to workshops, in which the machinery and carriages for use on the Railway are manufactured; and two have been fitted up as dwelling-houses, which are at once compact and convenient. When it is considered that the whole course of the arches has become a thoroughfare, which in process of time will become thickly populated, there is no doubt that this part of the speculation will become an additional source of profit; and the more especially as a footpath is already constructed on the south side of the viaduct, on the ground, along which foot-passengers are allowed to walk on payment of one penny each, which will be willingly paid when the road to Greenwich or Deptford is so materially shortened. This toll is another valuable item in the calculation of profit, independent of freehold frontages, and the probability that a carriage-road will be opened on the northern

side of the arches. The houses in the arches comprise six rooms, and are warmed with gas.

From the Deptford end of the road, a branch is to extend to the new Deptford Pier, now in progress. In addition to this, the Croydon Railway Company have entered into an agreement with the Greenwich Company, by which a junction of the two Railways will take place, about a mile and three-quarters from London-bridge. This has been effected under the superintendence of the engineer of the latter. A signal-man will be stationed at the junction, whose duty it will be to give notice of the approach of either of the trains, as is the case on the Manchester and all other Railways. The time occupied in coming from one Railway to the other will be less than one minute, so that very little delay will be occasioned.

In order to avoid confusion at the London end of the Railway, there are six lines of rails, into which the coming trains may be impelled, like coaches in an inn-yard; and there is room for laying down two more rails if necessary, the space being 280 or 300 feet in length, and 60 or 65 feet in breadth, all of which is inclosed with parapet walls. A large plot of ground is reserved, which can, if requisite, be obtained by the Croydon from the Greenwich Company, for a distinct station of the former; and as the whole line of Railway will be lighted by gas, the facility of giving signals by night as well as by day becomes obvious. Should it be deemed necessary, from other junctions, (which are by no means improbable,) a sufficient space is retained for widening the present Railway; and this may be effected in eight or nine months, at an estimated expense of 100,000*l.*, including a double set of new rails.

The carriages have been partially running on the Railway, from the early part of the past year, from Deptford to Bermondsey-road, a distance of about two miles and a quarter; and since then from the end of Bermondsey-street, within a very short distance of the intended grand entrance. A splendid design for this structure, somewhat resembling one of the Roman triumphal arches, appeared in No. 3 of the new series of the Railway Magazine.

Curiosity has, of course, drawn a vast number of persons to make the experiment of a trip by this new conveyance. At first, two engines or tenders only were in use, but six have since been completed, and are in constant use, going backwards and forwards every half hour, and oftener, as circumstances may require; and the repetition of these excursions may be increased to trains starting from each end every five minutes, with perfect safety. The trains to Deptford go on the right-hand rail, and those coming from thence on the left; they generally stop, going and coming, to put down and take up passengers at the Bermondsey-road. The carriages are of various constructions; some being close omnibuses, for which the fare is 1*s.*; other car-

riages open at the sides, but close at each end, the fare 9*d.*; and others open all round, for which the fare is 6*d.* The carriages are accompanied by guards, in the livery of the company, dark green cloth, with a section of the railway on the button. The distance from Tooley-street to Deptford is generally accomplished in less than ten minutes, including stoppages and the necessity of starting and coming in at an easy rate; a part of the journey is, however, done at the rate of 25 miles an hour, a proof that in going long distances without interruption, the speed may be easily increased. The carriages may be increased according to the demand, and one engine may take 11 or 12,000 passengers *per diem.*

The locomotive engines employed on this railway are upon entirely a new construction: the frames are so formed that the wheels cannot deviate from the rails at any speed, and their revolving motion can be instantly changed to a sliding motion; thus, the trains being powerfully retarded by friction, are speedily brought to rest, and the risk of accidents to the passengers is materially diminished.

Although it is not our intention to enter fully into the calculated financial results of the construction of this railway, we shall glance at a few of the advantages which it promises to the public. Mr. Herapath considers one of the most valuable features of the design to be the railway "coming so completely into the metropolis, as London Bridge is;" and that it, consequently, must monopolize all railways from the south and south-east of London. Whatever may be the success of these railways, when formed, they will be so many streams of profit to the Greenwich railway. "Thus, without considering its own traffic, which will, doubtless, be very great, the Greenwich line, like the trunk of a tree, must gather strength and bulk from every branch it sends forth." Mr. Herapath proceeds to estimate the profits which are likely to accrue from these branch lines and other sources, and concludes that the company will probably draw from the public no less than 28 per cent. per annum, without even using their own line, and with scarcely any counterbalancing expense.

The railway was opened on Wednesday, the 14th of December, by the first starting of the train from the commencement of the line at the principal entrance from Duke-street, London-bridge; when the Lord Mayor, the Lady Mayoress, and Sheriffs, took their seats in the first carriage; the journeys to and from Deptford were performed in 14 minutes each way.*

GLASS BALANCE-SPRINGS FOR CHRONOMETERS.

On May 19th, a paper was read, before the Royal Society, entitled, "On the application of Glass as a substitute for metal

* Abridged from the Mirror, No. 810.

balance-springs in Chronometers" By Messrs. Arnold and Dent. Communicated by Francis Beaufort, Esq., Captain R.N., F.R.S., Hydrographer to the Admiralty.

In their endeavours to determine and reduce the errors arising from the expansions of the balance-spring of chronometers consequent on variations of temperature, the authors came to the conclusion that there exist certain physical defects in the substances employed for its construction, beyond the most perfect mechanical form that can be given to it, which interfere with the regularity of its agency: so that however exquisite may be its workmanship, and however complete its power of maintaining a perfect figure when in different degrees of tension, yet the imperfect distribution of its component parts may give rise to great incorrectness in its performance. Hence the balance-spring not only should be made of a substance most highly elastic, but its elasticity should not be given to it by any mechanical or chemical process; as a body in motion, it should be the lightest possible; and, as far as the case admits of, it should be free from atmospheric influence. Glass suggested itself as the only material possessing, in the greatest degree, all these desirable properties. Its fragility, although apparently a great objection to its employment, was found, on trial, to constitute no obstacle whatever; for it was found to possess a greater elastic force than steel itself, and thus to admit of greater amplitude in the arc of vibration.

It was first proposed to ascertain how far a glass balance-spring would sustain low temperatures; and it was found by experiment that it resisted completely the effects of a cold as great as that of $+12°$ of Fahrenheit's thermometer; thus satisfactorily removing any objection which might be brought against its use from its supposed fragility in these low temperatures. The next object of solicitude was to determine whether it would withstand the shock arising from the discharge of cannon in the vicinity; and its power of resisting concussions of this nature was fully established by experiments made with this view on board H.M.S. Excellent, at Portsmouth.

On comparing the performance of glass balance-springs with metallic ones, when the temperatures were raised from 32° to 100°, it was found that while the loss in 24 hours in the gold spring was 8m. 4s., that of steel 6m. 25s., and that of palladium 2m. 31s., that of a glass spring was only 40s. These differences the authors ascribe principally to the different degrees in which the substances had their elasticity reduced by an increase of temperature. As glass was thus found to suffer a much smaller loss of elasticity by this cause than metals, they proceeded to construct a glass balance suited to the correction of the small error still occasioned by this cause, employing a glass disc for this purpose. The compensation being completed, they next tested the isochronism of the glass spring, and it proved to be as perfect as any metallic spring.

Chronometers thus constructed are now in course of trial at the Royal Observatory. In common with all other instruments of the same kind they have shown a disposition to progressive acceleration, the cause of which is but little known, but which appears to be influenced by the action of the air.*

EMPLOYMENT OF IRON IN SUSPENSION BRIDGES.

M. Martin has concluded from his observations, that the employment of bars of iron in suspension bridges is more proper than that of wire cables, as being more solid, more durable, and more economical. The experiments of the French marine prove that, in relation to resistance to fracture by extension, there are two distinct classes of iron, soft and hard iron. The soft is the only one proper for the manufacture of ship cables. In consequence of its softness, it can suffer an elongation of one-fifth of its length before breaking. This quality of iron answers well for suspension bridges. The security of cables would appear to depend upon their property of not breaking until they have suffered great elongation. Hemp cables, from experiments made at the hydraulic press of the forge of Guerigny, undergo a much less elongation before breaking than chain cables. It appears that iron chain cables are cheaper than wire cables for suspension bridges. The greatest objection against the employment of iron is its tendency to oxidation; but this is remedied, in a great measure, by the mode of suspension, so as that the chains may be placed in a condition to last, in proportion to the other parts. The Langon, on the Garonne, is referred to by Martin as an example of iron lasting well.†

* Philosophical Magazine, No. 55.
† Annales des Mines.

CHEMICAL SCIENCE.

EXPERIMENTS MADE AT CONSTANTINOPLE ON DRUMMOND'S LIGHT, FOR THE PURPOSE OF LIGHTHOUSE ILLUMINATION IN THE BLACK SEA.

By W. H. Barlow, Esq., Civil Engineer.

It may be well to state, as introductory to the following letter, that Mr. W. H. Barlow has been a resident for some time in Constantinople, for the purpose of constructing a brass-foundery and boring-apparatus, upon a large scale, with a view of remodelling the Turkish artillery; and that on the return of Namik Pasha from this country, (who had examined with a scrutinizing eye many of our manufacturing and scientific establishments,) Halil Pasha, the sultan's son-in-law, sent for Mr. Barlow, and spoke to him on the subject of restoring some dilapidated lighthouses in the Black Sea, and requested to know if he was acquainted with a very remarkable light which was known in England under the name of Drummond's lamp. He was answered that he knew of it generally, and that if he could find any description of it in any of his books, he would furnish him with the particulars. Fortunately, on referring to an ingenious Armenian physician, Dr. Zohrab, who had studied at Edinburgh, he fell upon a number of the Nautical Gazette, in which an account was given of the light; and, on the ground of the information thus obtained, the experiments detailed in the following letter were undertaken.

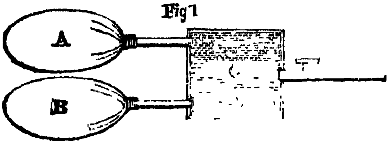
Constantinople, Jan. 6, 1836.

I have already informed you of my first experiments on Drummond's light, and the astonishment it produced in the Turks when it first shone forth in all its brilliancy. "Mashallah allah gunez boo!" was heard on all sides; and I must acknowledge that my astonishment and delight were no less when I first found my attempts successful, in which Dr. Zohrab equally participated, neither of us having ever seen it in England. I promised you that on my return from examining and reporting on the state of the lighthouses in the Black Sea, I would give you a detailed account of my proceedings, a promise which I now propose to redeem, as far as the extent of a letter will permit.

When Halil Pasha first mentioned the Drummond's light, having searched my own library in vain for any description, I applied to Dr. Zohrab, who, having studied in Edinburgh, and

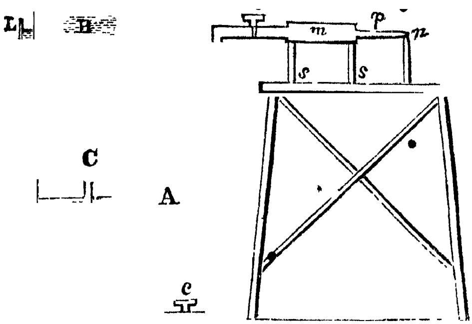
being in the habit of reading English works, I thought might possess the desired information; and, fortunately, he had a number of the Nautical Gazette, in which was given several particulars of the light, with drawings; and, as we were reading of its beauties, a sudden thought struck us of trying to make it. I set to work that night, and made a drawing of the simplest apparatus I could conceive capable of producing the desired effect, which was as follows. In fig. 1, A and B are two bladders, one containing oxygen, the other hydrogen. C is the mixing-box, to which they are attached by being firmly tied upon the two projecting pipes. In this box were placed about thirty pieces of wire gauze, which, by the by, we were sadly at a loss to obtain till we accidentally fell upon two wire gauze masks which had been used at the last carnival; these were instantly cut up and arranged in the mixing-box, at the upper end of which we attached the small pipe and stop-cock as in the figure. The stop-cock belonged to an apparatus of Dr. Zohrab's, and the small pipe was made by an ingenious Armenian at Galeta. Thus prepared, we filled the bladders with the proper gases (after only one unsuccessful attempt), and a piece of lime placed on a lump of clay was put before the jet; a board was then placed on the bladders, with a weight on it. We then lighted the jet, and, to our inexpressible joy, a light instantly burst forth so intense that it was impossible to look directly at it. This being accomplished, and our apparatus appearing safe, I determined to exhibit the light itself to the Pasha, instead of the drawing of it which I had promised him. The astonishment and approbation were, as I have stated, very great, and I was immediately dispatched to the Black Sea, to examine and report on the state of the lighthouses. On my return, I was requested to make a larger and more complete apparatus, in which I have succeeded to the full extent of my expectation. This last light burns for an hour; it is described below. But I must here first mention a circumstance attending our first exhibition: after this was over, Dr. Zohrab and myself removed our apparatus, and there being still some gas in the bladders, we lighted it again for our own amusement in my drawing-office, when it exploded with great violence while I was pressing the bladders with my hands. You remember the explosion of my gases in my little room at Rushgrove cottage, but that was nothing; this was so sharp that I lost the sensibility of my right ear for nearly a month, and the explosion forced pieces of the bladders quite through the cloth of my trousers; and yet, excepting my ear, I escaped without injury.

Fig. 1



In my large lamp it was necessary to have recourse to gasometers instead of bladders. These, according to Drummond's description, were to act under a pressure of 30 inches of water; and our explosion had taught us that this pressure must be very equable, to prevent the mixing of the gases in any great quantity. Many were the schemes I had, and rejected, but at last I adopted the following:—A, fig. 2, is a cylinder of tin, two feet in diameter, and four feet six inches high, closed at the bottom, and open at the top; B is another cylinder, one foot nine inches in diameter, of the same height, having a diaphragm of one foot eight inches from the bottom; this formed the hydrogen gasometer, and was used as follows: From the bottom of the larger cylinder rose a pipe, D, to the height of one foot nine inches, and a small recess was made an inch deep in the diaphragm of

Fig 2.

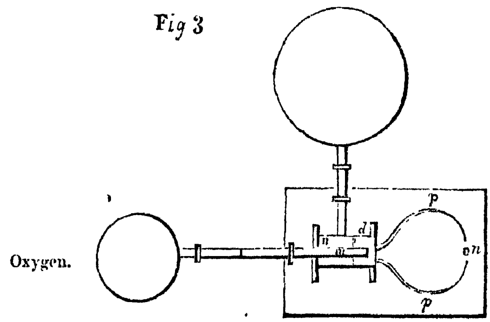


(Experiments with Drummond's Light.)

the inner cylinder to receive its end; the inner cylinder, therefore, being placed within the other, its edge rested on the bottom of the latter. To fill the gasometer, the interior cylinder was taken out, and water poured into the other to the level *l*; the former was then replaced, the stop-cock *c* opened, and the air expelled till the diaphragm reached the surface of the water; the gas was now introduced at the stop-cock, and the gasometer thereby raised: twenty-seven inches of water were now poured into the part B, which, together with the weight of the tin, made up the whole pressure of thirty inches. This forced part of the water in D up the sides of the vessel, and other water was added till the external water rose to the level L, which is twenty-nine inches above the top of the pipe; and consequently restored the water in the lower part of the gasometer to its original level *l*. It is now evident that as many inches of gas as are let off are

supplied by the upper part descending; and the surface of the upper and lower diameter being the same, the level of the water at *l* and L always remained the same, and consequently the pressure. There is, moreover, very little friction, and the action is soft and equal. The oxygen gasometer was constructed in the same manner; but being only required to hold half the quantity, its area of bottom was made only half the former, the height being the same. The other parts are easily comprehended: *c* is another cock; *m*, the mixing-box; *s s*, its supports; *p*, the emission-pipe; and *n*, the lime-ball. Fig. 3 is a plan of the whole, showing both gasometers. The mixing-box is made by soldering the pipe *m* into the outer pipe *n*, which has a diaphragm pierced with holes; the part of the pipe *m* projecting through it has also holes round its side.

Fig 3



(Experiments with Drummond's Light.)

The lamp is lighted thus: the hydrogen being let on by its stop-cock being opened, passes into *n*, and through the diaphragm *d* into *c*, and passes out through the pipes *p p*; this is now lighted, and it burns with a red, unsteady flame; then the oxygen stop-cock is turned gradually, when this gas passes through the holes into *c*, where it mixes with the hydrogen, and they come out in perfect union at the pipes *p p*. The hydrogen cock is now fully opened, and the other cock gradually opened and adjusted till the lime-ball gives out its most brilliant light, when the hydrogen flame entirely disappears.

The difficulties we encountered, and the extraordinary shifts we were put to, would be very amusing to you, but they are too long for a letter; suffice it to say, that, in the end, the experiment succeeded beyond our most sanguine expectation. The Pasha was delighted with its performance, and has taken the apparatus to his palace. I have since exhibited to him coal-gas light, which I managed much easier, and have drawn out my

estimates for this light and oil; but no doubt the latter will be preferred, and I soon expect to be at work in putting in proper repair the lighthouses of Fanaraki. I am anxiously waiting your further description of Beale's light, which I will also show to the Pasha, who takes great interest in all these matters.*

FORMATION OF SULPHURIC ACID.

By Thomas Thomson, M.D.F.R.S.L. and E., &c.

It is well known that sulphuric acid is manufactured in this country by the combustion of sulphur. The sulphurous acid formed is passed into large leaden chambers, where it comes in contact with nitric acid and a small quantity of water; the fumes of the nitric acid being sent into the leaden chamber at the same time with the sulphurous acid. Now, whenever any sloping part occurs in the leaden chamber at some height above the floor, which is covered with water, there is a deposit of a white saline matter.

This saline matter is in small scales. It has an excessively acid taste. When exposed to the air, it gradually runs into a liquid, which is pure sulphuric acid. When thrown into water, a violent effervescence takes place; nitrous gas is given off in abundance, and a solution of sulphuric acid remains. This saline matter has been repeatedly examined. Davy considered it to be a compound of nitric acid and sulphurous acid. Dr. Henry examined it some years ago, and concluded from his experiments, that it is a compound of hyponitrous acid and sulphurous acid.

By the kindness of Mr. Tennant I have had repeated opportunities of examining this matter in a state of great purity. I have subjected it to various experiments, and have been led to form a different opinion from that entertained by Dr. Henry of its composition. How far the experiments which I shall detail warrant that opinion, I leave to practical chemists to determine. The analysis is not quite satisfactory, because we cannot determine experimentally the quantity of water present.

1. When a quantity of the saline matter is mixed with water in a retort, a strong effervescence takes place, and nitrous gas escapes in torrents. The whole dissolves in the water, with the exception of a small quantity of white matter, the weight of which varies in different specimens. This white matter, when dried, is a tasteless powder, insoluble in water. When heated, it takes fire, and burns with a blue flame, while some sulphur sublimes. What remains is pure sulphate of lead. These phenomena characterize sulphite of lead. Hence, it is evident, that the saline matter from the leaden chambers contains sulphite of lead. From 550 grains of saline matter I obtained 8·43 grains of sulphite of lead, or about 1·53 per cent. In another experiment, 160 grains of the saline matter yielded 1·4 grains of sulphite of lead, or somewhat

* Philosophical Magazine, No. 46.

under one per cent. These two experiments show the two extremes; in all the others the quantity was intermediate.

2. Fifty-eight grains of the saline matter were heated in a small retort. The solid matter became partially liquid, and fumes of nitrous acid made their appearance. On increasing the heat, an effervescence took place, and gas passed rapidly. It was yellow, like nitric acid fumes, and like that acid acted on mercury, which prevented me from collecting the gas. When the effervescence stopped, a colourless liquid remained, with a small deposit of sulphite of lead, at the bottom of the retort. This liquid was colourless, but it effervesced violently, giving out nitrous fumes, when mixed with water. It remained, therefore, the same mixture or compound as the original saline matter.

3. When the saline matter is triturated with carbonate of ammonia, combination takes place without any sensible decomposition.

4. It was triturated with a quantity of bi-carbonate of potash in powder, which, from previous experiments, was judged capable of just saturating the uncombined acids. Fumes of nitric acid were given off till the whole became quite dry. The trituration being continued, the mixture softened into a white paste, which was left exposed to the air for some hours. On examining this residue, it was found to consist chiefly of a mixture of sulphate of potash and carbonate of potash, with a very little nitrate; the nitric acid had been almost all dissipated during the trituration.

5. One hundred and sixty grains of the dry saline matter were put into a retort, mixed with water and the deutoxide of azote, collected as it was extricated. The quantity of this gas evolved, supposing the thermometer at 60°, and the barometer at 30 inches, was 59·35 cubic inches.

The liquid in the retort being freed from the sulphite of lead, was found to be a solution of sulphuric acid in water, without any trace of nitric or sulphurous acid. This sulphuric acid being obtained partly in the state of sulphate of soda, and partly of sulphate of barytes, amounted to 132·24 grains = 105·79 grains of sulphurous acid.

The weight of the nitrous gas obtained was 19·17 equivalent to 34·5 grains of nitric acid.

The constituents obtained were,

Sulphurous acid	105·79
Nitric acid	34 50
Sulphite of lead	1·40
	141·69
Loss	18·31
	160·

This loss must be water. The constituents then are very nearly

1 atom nitric acid	6·75
5 atoms sulphurous acid	20·00
3 atoms water	3·375
	30·125

That the acid present is nitric, and not hyponitrous, I infer

from the phenomena of the distillation of the saline matter. And from our knowledge of the fact that nitric acid is actually introduced into the leaden chambers along with sulphurous acid, and there being nothing present to convert it into hyponitrous.

There is no evidence from the analysis that the whole acid of sulphur was in the state of sulphurous acid. I am induced, from the proportions found, to suspect that 2 8ths of it was in the state of sulphuric acid, and 3-5ths in that of sulphurous acid. On that supposition, it is easy to see how the atom of nitric acid, by giving out 3 atoms of oxygen, converts the 3 atoms of sulphurous into sulphuric acid, while the acid thus decomposed makes its escape in the form of deutoxide of azote.

The preceding analysis was repeated with very nearly the same result. If the supposition of the saline matter containing 2-5ths of sulphuric and 3 5ths of sulphurous acid be admitted, then the constitution of the portion examined must have been

Sulphurous acid	63 87
Sulphuric acid	52 90
Nitric acid	34 50
Sulphite of lead	1·40
Water	7·33
	160·00

This approaches pretty closely to

3 atoms sulphurous acid	12
2 atoms sulphuric acid	10
1 atom nitric acid	6 75
1 atom water	1·125
	29·875

Probably the water was in combination with the sulphuric acid.*

EFFECTS OF COMPRESSED AIR ON THE HUMAN BODY.

Dr. Junod has communicated to the Academy of Sciences the following results of his experiments with compressed air.

In order to operate on the whole person, a large sperical copper receiver is employed, which is entered by an opening in the upper part, and which has a cover with three openings; the first for a thermometer, the second for a barometer or manometer, and a third for a tube of communication between the receiver and the pump. The air in the receiver is perpetually renewed by a cock.

When the pressure of the atmosphere is increased one half, the membrane of the tympanum suffers inconvenient pressure, which ceases as gradually as the equilibrium is restored. Respiration is carried on with increased facility; the capacity of the lungs seems to increase; the inspirations are deeper and less fre-

* Thomson's Records, No. 20.

quent. In about fifteen minutes an agreeable warmth is felt in the interior of the thorax. The whole economy seems to acquire increased strength and vitality.

The increased density of the air appears also to modify the circulation in a remarkable manner; the pulse is more frequent, it is full and is reduced with difficulty; "the dimensions of the superficial venous vessels diminish, and they are sometimes completely effaced, so that the blood in its return towards the heart follows the direction of the deep veins. The quantity of venous blood contained in the lungs ought then to diminish, and this explains the increased breathing of air. The blood there is then determined in larger quantity to the arterial system, and especially to the brain. The imagination becomes active, the thoughts are accompanied with a peculiar charm, and some persons are affected with symptoms of intoxication. The power of the muscular system is increased. The weight of the body appears to diminish.

When a person is placed in the receiver and the pressure of the air is diminished one-fourth, the membrane of the tympanum is momentarily distended; the respiration is inconvenienced, the inspirations are short and frequent, and in about 15 or 20 minutes there is a true dyspnœa. The pulse is full, compressable and frequent; the superficial vessels are turgid. The eyelids and lips are distended with superabundant fluids, and hæmorrhage and tendency to syncope are sometimes induced; the skin is inconveniently hot, and its functions increased in activity; the salivary and renal glands secrete their fluids less abundantly.*

DR. URE'S PATENT CORRUGATED SUGAR-PAN OR TEACHE.

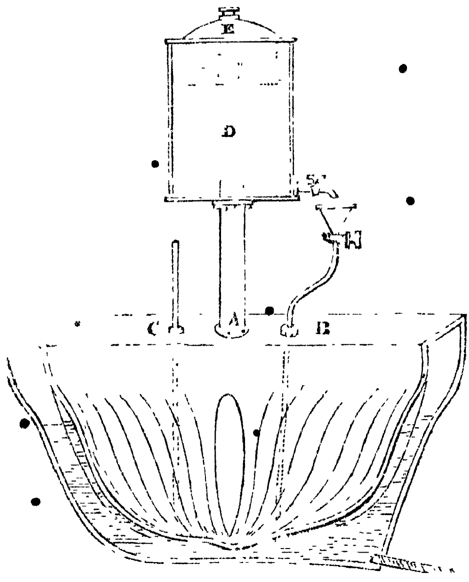
THE pan is made of cast iron, and is double. Between the outer case, which is evenly, and the inner one, which is corrugated into a double surface, there is a space for containing a liquid medium, which is unalterable by the fire in any length of time, and serves as a bath to transmit a sufficient heat to boil the syrup very quickly, but intercepts the scorching temperature which turns it into molasses. The sugar, therefore, cannot be burned in the inner pan, and the fire need never be extinguished, as at present, when a skip is struck. Thus, much time, labour, and fuel, are saved. The pan may be set up by any bricklayer, at the end of the ordinary range of coppers in a colonial sugar-house, where the finishing teache now stands; or it may be worked by a separate fire, at the pleasure of the planter, and may have the spare heat of its flue applied to the clarifier coppers.

Fig. 1 is a section of the double pan. Being as tight as a bottle, and without seams or joints, it is not liable to leak, like pans made of copper,

* Journ. de Chim. Méd., June, p. 13, quoted in the Philosophical Magazine, No. 52.

which must be rivetted or brazed. G is the vacant space between the two pans for the play of the bath-liquor during the time of skipping, when no evaporation is going on in the inner pan. H shows the level of the bath-liquor about two-thirds up the side corrugations. A is a bent pipe, three inches wide, for connecting the space between the pans with an iron drum, D, called the condenser. Any watery vapour which may occasionally exhale from the bath, when overforced by fire, rises freely up the pipe A, and is condensed into water in D. The water thus condensed is quite pure, and is allowed to trickle slowly down through the stop-cock F into the funnel beneath it, from which it runs back into the bottom of the medium through the pipe B, and thus preserves the boiling pitch of the medium always at the requisite temperature. The best heat of the medium for boiling sugar quickly without discoloration has been found to be from 300 to 310 degrees of Fahrenheit's thermometer; but it may vary a few degrees up or down without inconvenience. The

Fig. 1.



(Dr. Ure's New Sugar-pan.)

temperature of the bath may be made higher or lower, at the pleasure of the boiler. By merely preventing some of the water that exhales into the condenser D from returning into the bottom of the bath, the temperature is raised; and by pouring slowly a little more water into the bath through the pipe B, the temperature is lowered. A few quarts of water added make a difference of several degrees in the heat of the bath. E is a light basin of cast iron, inverted over the open top of the safety-pipe of the drum D. The edges of the basin rest on three

iron props, and dip an inch deep, or thereby, into some water poured round them, in the upper space of the drum. This arrangement forms a water-valve, which allows air or steam to pass freely to and from the bath-space between the pans, but at the same time cuts off the open communication between the external atmosphere and the bath-liquor. This liquor consists of a strong solution of caustic potash, and may be preserved any number of years in a perfect state for sugar-boiling, by this plan of seclusion from the open air. Should the body of medium after a long time absorb so much carbonic acid or fixed air, as to impair its action as a bath, it may be easily made caustic again, and thus restored to its original state, by boiling it for half an hour in a copper with half a hundred weight of fresh slaked quick lime, and six times its bulk of water. This lime-mixture being allowed to settle a night in the large copper in which it was boiled, must be ladled off into a smaller copper in successive portions, and boiled down till its boiling pitch rises to 290 degrees, or thereby. The copper should be partially covered with boards during this boiling up, and whenever the liquor is concentrated enough, the copper should be closely covered with boards or mats, till the liquor has become cool enough to be poured into the bath-space through the aperture at C or B (unscrewed for this purpose), by means of a funnel, or a stone pitcher, with a spout.

The flange A, of the bent pipe, is made water-tight to the brim of the pan by a lead-washer, and is fixed down firmly with screw-bolts, having square heads. The funnel-pipe, B, with the lengthening piece, for introducing water into the bottom of the medium for regulating the temperature of the bath, is fixed in its place by a union-joint screw, turned by a screw-key or wrench. The thermometer tube-case has a flange, with lead-washer, at C, by which it may be screwed tight into its aperture. Into this tube, which is shut at bottom, an inch or two of quicksilver is to be poured, or sufficient for covering the bulb of the thermometer. This quicksilver lying always in the tube, takes the temperature of the medium, and immediately imparts it to the thermometer, on dipping its open end down into the bottom of the quicksilver. The thermometer, after some experience in boiling with the pan, need only be used occasionally, as in the morning and afternoon. It shows at once whether the bath is too hot or too cool, so that a little water may be poured into it through B in the former case, or a little of the condensed water in D allowed to run to waste, by the stop-cock F, in the second case.

The condensing-drum D must be propped in its proper position, while it is being fixed on to the brim of the pan by the screw-bolts of the flange A. When the pan is briskly at work, both stop-cocks for regulating the medium may be shut, and slightly opened only when the pan is charged afresh with syrup; or the stop-cocks, after a little practice, may both be left always slightly opened, whereby the pan will become self-acting, by the circulation of a little vapour into the condenser, and a return of it in the state of water to the bottom of the bath. Water poured on the surface of the dense medium does not incorporate with it, and therefore has little or no effect on its temperature.

Fig. 2 is a section of the patent pan when set as the first of the range. A is the flue leading to the other pans. BB, the shuttle-valve, or dampers, of fire-brick, by means of which the orifice of the flue may be lowered when required; thereby allowing the flame to have less contact with the bottom of the patent pan. C is the medium discharge-pipe, to be made

use of only on finishing crop, when the medium ought to be run off into an iron drum, where it would remain free from the influence of the atmosphere till the following season. D D represent the circle of fire-bricks upon which the patent pan is seated.

Fig. 3 represents more clearly the action of the dampers, as previously shown. These are placed betwixt the patent pan and the second of the range. A and B are the two dampers, equal in weight, and consequently of easy adjustment. When the dampers are furthest apart, the patent pan is receiving the full influence of the fire, but as they approach each other the flame is sucked more rapidly through the diminished orifice, and is in consequence allowed less contact with the bottom of the patent pan.

Fig. 2.

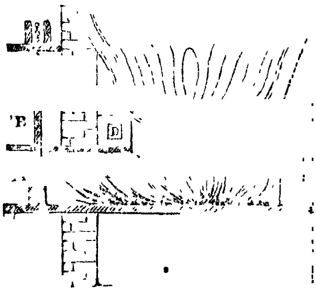
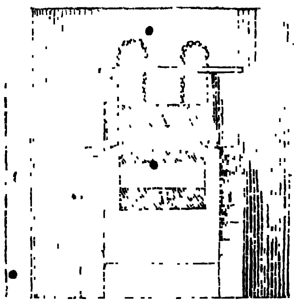


Fig. 3.



(Dr. Ure's New Sugar-pan.)

By these means the fierceness of the fire, as applicable to the patent pan, may be completely controlled, without the least waste of fuel; for while little of the heat is acting upon the patent pan, more is made available to the other pans of the range.

The medium is carefully prepared under the superintendence of the patentee, in a laboratory fitted up on purpose, and is sent out in a state ready for use, in an iron drum-tank, packed in a cask. The orifice of the tank is closed with a screwed iron plug, having a lead-washer under its flange. On taking out this plug with a common screw-wrench, the medium must be poured by portions into a stone or metal pitcher, and thence into the bath-space between the pans; the discharge-hole at the bottom of the pan having been previously closed tightly with its screwed-pipe, and flange with lead-washer. At the other end of this short pipe there is a stop-cock, which is never to be opened but when the bath-liquour is to be drawn off at any vacant period, for the purpose of making it caustic again after some years' use. This stop cock should in general be incased in brick-work or mortar, to screen it from idle fingers. The

bath-liquor is corrosive to skin and wood, and should not be put into wooden vessels or much handled; if a little happens to touch the fingers it may be washed away with a little water. Should some of the medium be found to be congealed, the bottom of the open tank may be plunged in boiling water for a little, or surrounded with blazing cane-trash, and half a gallon of hot water may be poured in to wash out the remainder.

Should the junction of the outer and inner pans, at their brims above, become in the least open at any time, they may be made secure again, by packing them with iron cement, made of ground iron-borings and sal-ammoniac, well mixed, in the proportion of six pounds of the former to one ounce of the latter, and very slightly damped with water.

When fire is first applied to the pan, after the proper charge of medium has been introduced into it, the progressive heating of the bath must be carefully observed by means of the thermometer, standing in the quick-silver tube C. If the temperature rises to 290 degrees, or thereby, the pan is ready for receiving its skip of cleaned syrup, which may be boiled in the common coppers of the gange to a boiling pitch of 220 degrees without discoloration. A charge of such syrup may be boiled off into good sugar, by the patent teache, in half an hour, and into fine syrup for shipment home in half that time. At the instant of running off the granulating skip into the cooler, the firing should be suspended, and resumed as soon as the fresh charge of syrup is introduced. The pans have a shelving brim, to which the usual sloping saddle of lead or mortar cement may be most conveniently adapted, for allowing the juice to froth up without boiling over. The bath is a constant magazine of heat, by which the hot syrup is made to boil briskly immediately after its introduction, so that not an instant is lost in the operation of a sugar house. This pan is also more easily managed than the simple teache, as it cannot by possibility burn the juice, the fierceness of the fire merely agitating the bath for a little, without affecting the quality of the sugar. When there is no syrup in the corrugated pan, the medium should not be forced with a strong fire, as having no evaporable liquor to transfer its heat to, it might possibly boil up a little into the condenser. Even in this case, no evil could result, since the moment that the fire becomes moderate, or that fresh syrup is put into the inner pan, the drop of medium which may have been forced up into the condenser D, can be run back into its proper place, through the stop-cock F, and subjacent funnel-pipe.

For some time after beginning to use the pan, it is proper to look every two or three days into the state of the bath, and to measure the depth at which it stands. This is conveniently done, at any interval of the boiling, by unscrewing the quicksilver pipe C, lifting it perpendicularly up, and noting how high the wet mark of the medium is. If it corresponds with about the middle height of the side corrugations, all is right; if it shows the medium to stand lower, a few gallons may be poured in from the spare tank. Too much medium is not advisable, as it merely heats the sides of the pan above the level of the granulated skip, and as it leaves too little space for the free play of the medium exposed to a fierce and fluctuating fire.*

ACTION OF SULPHURIC ACID ON OILS.

M. Fremy, in examining the kind of saponification which sulphuric acid exerts upon oil, has arrived at several facts in addition to

* Mechanics' Magazine, No. 657.

those already ascertained by MM. Chevreul, Braconnot, and Caventou. The oils employed were olive and almond, and the results from both were perfectly similar. When olive oil is treated with half its weight of concentrated sulphuric acid, surrounding the vessel with a freezing mixture to prevent any elevation of temperature and consequent evolution of sulphurous acid, the acid being added very cautiously, after a few minutes the mixture becomes viscid, when the action is finished. Then the mass being treated with water, rather less than six times the bulk of the oil employed, the mixture separates into two strata; the superior is of syrupy consistence, whilst the lower is chiefly composed of water and sulphuric acid; this latter is a sulphoglycerate of lime, (?) whilst the superior layer is a mixture of three acids, which he calls sulphostearic, sulphomargaric, and sulpholeic acids.

The aqueous solution of these acids decomposes in a few days, sulphuric acid being formed, and the three fatty acids precipitated.

The sulphostearic and sulphomargaric acids possess little stability, as they always decompose in from 24 to 48 hours at most, which property M. Fremy has availed himself of to separate these two solid acids from the third, which is liquid, and is derived from the decomposition of sulpholeic acid. The two solid acids can be separated by means of alcohol; these he has named hydrostearic and metamargaric acids.

Hydrostearic acid is solid, white, insoluble in water, soluble in both alcohol and æther, from which it crystallizes in mammillated groups; it fuses at about 129° Fahr. Its composition is $C^{35} H^{72} O^{5}$: it loses ½ an equivalent of water when in combination with bases. It may be volatilized without alteration. All its salts are insoluble in water, except the hydrostearates of soda and ammonia.

Metamargaric acid is white like the preceeding; soluble in alcohol; fuses at 120° Fah. Its composition is given in the formula $C^{35} H^{70} O^{4\frac{1}{2}}$. It loses ½ an equivalent (1½?) of water in combining with bases, and becomes $C^{35} H^{67} O^{3}$, that is exactly the same composition as common margaric acid.

Hydroleic acid is a slightly coloured liquid at 32° Fahr.; is composed of $C^{35} H^{66} O^{5\frac{1}{2}}$; loses ½ an equivalent of water by combination, and becomes $C^{35} H^{65} O^{5}$. When distilled it is almost totally decomposed into carbonic acid, water, and an oil composed almost wholly of two new hydrocarburets. These are liquid at ordinary temperatures; their composition is the same, but the density of their vapours differ, one boiling at 131° Fahr., the other at 226° Fahr. The first he has named oleene, the second elaene. Oleene is a white limpid fluid, burns with a vivid flame, and is composed of carbon 85·95, hydrogon 14·05, or CH^2. Thus this hydrocarburet appears to be isomeric with carbohydrogen, &c. &c.

Elaene is white, less fluid than oleene, boils at 226° Fahr.; its odour is more penetrating than that of oleene, but its elementary composition is the same. It is insoluble in water, but dissolves in alcohol and æther. It combines with chlorine in the proportion of 4 vols. of chlorine to 4 of elaene.

Hydroleic acid treated with concentrated sulphuric acid forms sulpholeic acid, which is soluble both in water and alcohol, and of a slightly acid, and very bitter taste. The sulpholeates of the alkalies are soluble, but have not been crystallized. Sulpholeate of lime is composed of 2 eqs. of hydroleic acid, 1 eq. of sulphuric acid, 1 eq. of lime, and 1 eq. of water. From these experiments it appears that sulphuric acid exerts a kind of saponifying influence on oil; forming glycerine, which combines in its nascent state with sulphuric acid; and fatty acids, which form similar combinations. From the knowledge that fat substances under such different actions always give rise to glycerine and fatty acids M. Fremy argues that they are educts and not products pre-existing in fatty bodies.*

ON THE COMPOSITION OF BITUMENS.

By M. Boussingault.

THE bitumens which are so abundantly spread over the face of the globe, and whose uses are every day becoming more varied and extensive, have hitherto been little examined. If we except the labours of M. de Saussure upon the naphtha of Amiano, we are nearly in complete ignorance concerning the intimate nature of these bituminous compounds.

It is to this insufficiency of the data supplied by chemistry that we must attribute the confusion into which most mineralogists have fallen in their attempts to classify the different bitumens. A systematic place can easily be assigned to naphtha, idrialine, and mellilite or honey-stone, but when we come to petroleum we get involved in difficulties; this substance usually met with in a liquid state, now becomes viscid, and successively presents all possible degrees of consistence, till we arrive at asphaltum, which is solid and brittle. We are generally led to admit that the bitumens owe their fluidity to naphtha; but the results of the present investigation show that there is no ground for this supposition. The attention of the author was first directed to the viscid bitumen of the *Departement du Bas Rhin.* After describing the method in which the bituminous sand is treated, he gives a rapid sketch of the locality of bitumens, and shows that the immense masses of mineral pitch which are found on the banks of the River Magdalena, at Payta, upon the coast of Peru, have a geological position precisely similar to that in which we find bituminous impregnated sands in Europe; that is to say, in forma-

* L'Institut; quoted in the Philosophical Magazine, No. 52.

tions which we must refer to the supercretaceous group. The only contradictory fact opposed to this conclusion is that recorded by M. de Humboldt, when he states, that at La Punta d'Araya, in the Gulf of Cariaco, he saw petroleum issuing from mica-slate.

The bitumen of Bechelbronn is viscid, of a very deep brown colour. The uses to which it is applied have procured for it the name of mineral grease.

Heated to 120°, this bitumen does not yield any product; but, on distilling it with water, an oily principle is procured, which is volatile, of a pale yellow colour, and in which analysis shows there is nothing else than carbon and hydrogen. As this carburetted hydrogen appears to constitute the principal liquid of bitumens, the author designates it by the appellation of *Petroline.*

Petroline boils at 280° of the mercurial thermometer; its odour is that of bitumen; at 21° its weight is 0·891, even at a cold of 12° it does not lose its fluidity; alcohol dissolves it in small quantity, and it is much more soluble in ether. It contains carbon 0·885, hydrogen 0·115, and is consequently isomeric with the essential oils of turpentine, lemon, and copaiba.

By using the methods employed by M. Dumas, it is found that the density of the vapour of petroline is equal to 9·415, whilst calculation indicates 9·533. This is precisely double the weight of the vapour of the essence of turpentine. If we admit that four volumes of vapour constitute an atom of petroline, its atomic composition will be as follows:—

Carbon, 80 atoms,	..	..	3,060·8
Hydrogen, 64 atoms,	..	..	400 0
			3,460·8

Independent of the petroline, there exists in the bitumen a black solid substance, which is absolutely insoluble in alcohol, and soluble in ether. M. Boussingault names this product *Asphaltine*, because it forms the base of that species of mineral which mineralogists describe under the name of asphaltum.

Asphaltine may be procured by subjecting bitumen purified by ether to the continued action of a temperatue of 240° or 250°. Asphaltum is solid, very black and brilliant, its fracture conchoidal; at a temperature of 300° it becomes soft and elastic, and is decomposed before the blowpipe. It contains Carbon, 0·753; Hydrogen, 0·099; Oxygen 0·148, a composition which is represented by the formulary $C.^{80}. H.^{64}. O.^{6}.$ which indicates that asphaltine is the result of the oxidation of petroline.

The bitumen of Bechelbronn, purified by ether, seems to be nothing more than a mixture of petroline and asphaltine. It contains Carbon, 0·870; Hydrogen, 0·112; Oxygen, 0·018.

On the whole, then, it would appear that glutinous bitumens are mixtures, probably in all proportions, of two substances,

which we can isolate, and which have each a definite composition. One of these principles is solid and fixed, and in its nature approaches to asphalt; the other liquid, oily, and volatile, resembles petroleum in some of its properties. Hence we may readily conceive how the consistence of bitumens varies in a way we may call indefinite; its degree of fluidity being regulated by the relative proportion of the mixture of its ingredients.

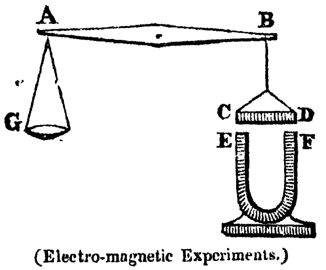
The analogy which exists between the asphaltine and the asphaltum of mineralogists, led me, says the author, to inquire if this analogy is maintained in their composition; I have submitted the asphaltum of Coxitambo, (Peru,) which may be considered as the type of the species, to analysis. This asphaltum has a fracture which is eminently conchoidal, with a high degree of lustre. The weight is 1·68; it is decomposed before the blowpipe, and when burned leaves 0·0,016 residuum. It contains Carbon, 0·750; Hydrogen, 0·095; Oxygen, 0·155.*

CAUSE OF THE REMARKABLE DIFFERENCE BETWEEN THE ATTRACTIONS OF A PERMANENT AND OF AN ELECTRO-MAGNET ON SOFT IRON AT A DISTANCE.

By the Rev. William Ritchie, LL.D., F.R.S.

As soon as the electro-magnet was constructed and employed to illustrate the immense magnetic power communicated to soft iron, it must have been observed that its attraction for iron filings or pieces of soft iron at a distance was much less than that of a permanent magnet of equal lifting power. This peculiar property rendered the electro-magnet not well suited for magnetic induction at a distance; and hence, after a few unsuccessful trials to substitute it for the permanent magnet in my apparatus for continued rotation, it was long since abandoned.

Experiment 1. Suspend a piece of soft iron, C D, at the extremity of a slender, delicate balance of light wood; place a permanent horseshoe magnet below it, and ascertain its attractive force, by weights put into the scale G, when it is in contact, and also when it is removed to different distances from the soft iron. Remove the permanent magnet, and substitute a very short electro-magnet of equal lifting power. Remove it to the same distances as before, and the attractive power will diminish very rapidly compared with that of the permanent steel magnet.



(Electro-magnetic Experiments.)

Exp. 2. Instead of the short electro-magnet, substitute a very long one (one of two or three feet

long, for example.) and of equal carrying power, remove it to the same distances, and ascertain its attractive power, and it will be found that its attraction for the lifter at these distances will not diminish so rapidly as that of the short one. The longer the electro-magnet becomes, the more does it approach to the character of the permanent magnet in all its properties.

Exp. 3. Instead of making the electro magnet of soft iron, make it of hard iron or untempered steel; repeat the preceding experiments, and its attractive power at a distance compared with its lifting power will be much greater than in the case of the electro-magnet of soft iron.

These facts, which, as far as I know, have not before been published, will enable us to account for this property on principles previously recognised. The perfect equality of action and reaction must be found to exist in this case as well as in every other in which force of any kind is concerned. The electricity which has been decomposed and arranged in the soft iron in the peculiar manner which constitutes magnetism cannot decompose and arrange the electricity belonging to the lifter without suffering a corresponding diminution, and the more difficult the arrangement in the lifter so much greater will be the diminution of power in the electro-magnet. Again, if the electricity in the electro-magnet be easily arranged by the induction of the voltaic helix, it will be easily forced back to its natural state by the reaction of that belonging to the lifter. Hence it follows that when the inducing power of the electro-magnet is very great, (which it is when the lifter is in contact with its ends,) it will possess sufficient power to vanquish the coercitive force of the lifter, arrange by induction a large portion of the electricity of the lifter, and thus exhibit powerful attraction. When the lifter is removed to a certain distance, one tenth of an inch for example, the power of the electro-magnet being much diminished in consequence of the distance, whilst the difficulty of overcoming the coercitive force of the lifter is increased, the effect will be very small compared with the former. For if the inducing power be only equal to the coercitive force of the lifter, no attraction whatever will take place; and hence the impossibility of magnetizing a large bar of steel tempered as hard as possible, by means of a small permanent magnet with a soft temper.

Now, if the coercitive force of the electro-magnet be increased, which is done either by employing a long magnet, or using hard iron or untempered steel, such a magnet will suffer a less diminution by the reaction of the lifter in the case of increased difficulty of arrangement in the lifter, than in the case of the short electro-magnet of perfectly soft iron.

In the case of the permanent magnet of tempered steel, the electricity belonging to it was arranged with difficulty, and after repeated touches of another magnet, and consequently it will easily vanquish the coercitive power of a piece of soft iron, and induce a magnetic state upon it, whilst the peculiar arrangement of its own electricity will remain nearly unchanged. Hence its

attractive powers will diminish nearly as the squares of the distances of the soft iron from its poles, or imaginary centres of accumulation, a law which cannot exist in the case of the electro-magnet the electricity of which is so easily put in motion round the elementary molecules of the iron by the reaction of the lifter.*

ARTIFICIAL PRODUCTION OF METALLIC SULPHURETS, &c., BY ELECTRICAL ACTION.

The Geological Section of the British Association for the Advancement of Science, having received as novelties some communications on this subject, we think it due to M. Becquerel to state, that he obtained by this means a very considerable number of substances, about seven years since. His apparatus consisted of a tube bent into a syphon shape U, the curved portion being filled with moistened clay, (l'argile pumectèe,) and the legs with solutions of the substances of which combinations were sought, and connected by a wire.

The crystalline metallic bodies which he obtained were,

Metallic copper.
Red oxide of copper.
Vitreous copper.
Grey copper (fahlertz).
Metallic silver.
Vitreous silver.
Chloride of silver.
Sulphuret of lead.
Carbonate of lead.
Sulphate of lead.
Oxy-sulphuret of antimony (kermes).

Besides a considerable number of alkaline sulphurets, chlorides, bromides, and many double sulphurets, salts, &c.

Full details will be found in M. Becquerel's work "de l'Electricite et du Magnetisme, tome i., 332—350."†

THE MANUFACTURE OF PLATINUM.

By M. Pelouze.

The method of Wollaston in the fabrication of platinum is only followed by those who make this metal an article of commerce. Chemists do not prepare malleable platinum for the requirements of their laboratories, and in their public lectures its preparation is never exhibited. M. Liebig is, I believe, the only one who manufactures it during his course. Although the method he follows is precisely that of Wollaston, and therefore presents nothing new in a scientific point of view, yet it may be alike useful and agreeable to chemists to retrace the steps of a process

* Philosophical Magazine, No. 52.
† Thomson's Records, No. 23.

which is too much neglected and so easy of execution, that we may say there is no operation whatever more simple or expeditious than that of the manufacture of malleable platinum, made in the simple apparatus described below.—It is a hollow cylinder slightly conical, one of the extremities of which is closed by a small but very thick metallic plate. After having decomposed at as low a temperature as possible the muriate of platinum and ammonia, the froth which is produced is separated by a piece of wood; with this and a little water a clear paste is to be made, and introduced into the cylinder: an iron piston is then introduced into the cylinder, and after having pressed it at first very gently for a minute or two, it is then compressed with the greatest possible force An iron ring, by which the base of the cylinder is supported, being struck with a hammer, affords us facilities for getting at the piece of platinum which is thus formed. The platinum taken from the cylinder has already a high density, and a brilliant metallic lustre. It is dried with a gentle heat; and, after having been exposed for a quarter of an hour to a white heat, it is rapidly withdrawn from the crucible, and receives a single blow of the hammer. It is then again exposed in the fire four or five times, and the number of the strokes from the hammer are only gradually increased. In less than half an hour the whole operation is finished; and it is so easy that the result is always certain. I now exhibit to the Academy a spatula and the blade of a knife of platinum, which I myself saw prepared in a few minutes at Giesen in M. Liebig's laboratory.*

ON FLUORINE.

By G. J. Knox, Esq., and the Rev. Thomas Knox

As far as the existence of a substance which had not hitherto been procured in an independent state could be determined, the experiments and reasoning of Davy and Berzelius are sufficiently conclusive. The only desideratum seems to have been the obtaining of a vessel upon which this energetic principle would exert no action. Since fluorine shows no affinity for the negative elements oxygen, chlorine, iodine, and bromine, nor for carbon or nitrogen, it would appear that the vessel to contain it should consist of some solid compound of those substances; but as such vessels would be unable to bear exposure to a high temperature, we considered that though they might be convenient for retaining the gas when once obtained, they would not answer for its production. It was therefore necessary to employ some substance already saturated with the element; and for this purpose fluor spar, from bearing exposure to a high temperature and being easily formed into vessels, appeared best adapted. The most convenient method of obtaining the gas seemed to be by acting upon fluoride of mercury

* Jameson's Journal, No. 43.

with dry chlorine, by which means, if the absence of moisture could be insured and the formation of a chloride of mercury obtained, fluorine must have been disengaged, and if present would be recognised by appropriate tests.

Placing dry fluoride of mercury in the fluor spar vessel, we heated it till a glass plate cooled by the evaporation of sulphuret of carbon showed no trace of moisture in the vessel; the chlorine was then passed through a desiccating tube filled with fused chloride of calcium, the tube being bent at an angle, and its extremity drawn capillary, so as to enter the vessel, which, when filled with the gas, has its orifice closed with a plate of fluor spar which was fastened firmly down.

After exposing it to the heat of a spirit-lamp for some time, on removing the fluor spar cover, and replacing it rapidly with one of silica, it showed immediate and powerful action. The inside of the vessel was found on examination to be covered with crystals of bichloride of mercury; both of which results prove the presence of either fluorine or hydrofluoric acid; to determine which, we repeated the experiment, cooling the cover of the vessel so as to condense any hydrofluoric acid which might be present, but none appeared, from which we inferred that fluorine and not hydrofluoric acid had been present in the vessel, which was also further confirmed by the absence of fumes, when the vessel and its contents had been previously dried.

Placing inverted over the orifice of the vessel a clear crystal of fluor spar, with a small perforation in the centre into which a stopper of fluor spar fitted accurately, on the stopper falling into the vessel, the tube was filled with a yellowish green gas, the colour of which deepened with heat, and disappeared when cold. On reheating the vessel below, the gas rose again into the crystal above. On removing the crystal while hot to a wet glass plate, it flew to pieces, which prevented us from determining whether the coloured gas was bichloride of mercury under heat and pressure, hydrofluoric acid, or fluorine.

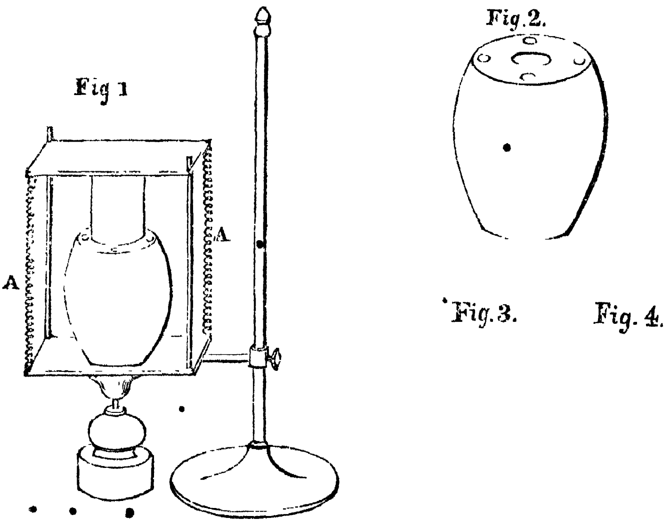
Having procured larger vessels with receivers into which ground stoppers were made to fit accurately, we resumed in the present month the experiments we had tried in the beginning of April.

1st Exp. We heated fluoride of lead with oxygen, and afterwards with dry chlorine without action upon the fluoride. When the receiver, (its stopper having fallen into the vessel below,) was placed over gold-leaf a chloride of gold was formed.

2nd. Exp. Treating hydrofluate of ammonia similarly with chlorine, there was strong action on glass and formation of chloride of gold as before.

3rd. Exp. Treating fluoride of mercury with chlorine, (as we had done in our former experiments,) we obtained crystals of bichloride of mercury in the vessel. Leaving the receiver over gold-leaf, there was after a considerable time action on it, producing a yellowish brown appearance. This we placed on a slip

of glass, and on adding a few drops of sulphuric acid and evaporating to dryness there was very strong action on the glass where the gold had been, proving that it was a fluoride of gold, and that since gold is not acted on by hydrofluoric acid there must have been fluorine in the receiver. As an additional corroboration there was no hydrogen in the tube, which there would have been had hydrofluoric acid been decomposed by the gold. From these experiments we conclude that fluorine was present in the receiver, but whether a slight trace of hydrofluoric acid, (to which the action on glass was due,) may not have been present with it, we have not yet determined. We hope on a future occasion to be able to give particulars with regard to the properties of the gas.



(Apparatus for Fluorine Experiments.)

Explanation of Figures.

Fig. 1. The vessel with the receiver in the stand which holds down the receiver by means of spiral springs A.

Fig. 2. Vessel with cover off, showing the orifice and the small depressions in which the gold-leaf, &c. were placed.

Fig. 3. Receiver without stopper.

Fig. 4. The stopper.*

To these interesting experiments may be added the following note:

M. Baudrimont states that he succeeded in isolating fluorine two years since: but he did not announce this discovery because

* Philosophical Magazine, No. 52.

he could not obtain it without a large admixture of oxygen gas. The process by which he first obtained fluorine was by passing fluoride of boron over minium heated to redness, and receiving the gas in a dry vessel. His present method is to treat a mixture of fluoride of calcium and binoxide of manganese with sulphuric acid in a glass tube; but the gas thus obtained is mixed with the vapour of hydrofluoric acid and fluosilicic acid gas; this mixture, however, does not interfere with the observation of the principal properties of fluorine, which is a gass of a yellowish brown colour, and possesses an odour resembling chlorine and burnt sugar: indigo is bleached by it; it does not act upon glass, but combines directly with gold.*†

MODE OF PREVENTING BEER FROM BECOMING ACID.

A PATENT has been taken out in America, for preserving beer from becoming acid in hot weather, or between the temperatures of 74° and 94°. To every 174 gallons of liquor, the patentee Mr. Storewell directs the use of one pound of raisins, in the following manner:—"Put the raisins into a linen or cotton bag, and then put the bag containing the raisins into the liquor before fermentation; the liquor may then be let down at 65° or as high as 70°. The bag containing the raisins must remain in the vat until the process of fermentation has so far advanced as to produce a white appearance or scum all over the surface of the liquor, which will probably take place in about 24 hours. The bag containing the raisins must then be taken out, and the liquor left until fermentation ceases. The degree of heat in the place where the working vat is situated, should not exceed 66° nor be less than 60°." To prevent distiller's wash from becoming acid, two pounds of raisins should be put into 150 gallons of the wash, the raisins being chopped and put in without a bag, and 106 of hops should be put into the wash vat for every eight bushels of malt at the time of washing, and ¾ of a pound of hops for every bushel of malt brewed, to be boiled on in the liquor in the copper.‡

MAGNETIC RELATIONS AND CHARACTERS OF THE METALS.

By Michael Faraday, D.C.L., F.R.S., &c.

GENERAL views have long since led me to an opinion, which is probably also entertained by others, though I do not remember to have met with it, that all the metals are magnetic in the same manner as iron, though not at common temperatures or under ordinary circumstances. I do not refer to a feeble magnetism,

* See Messrs. Knox's preceding paper.

† L'Institut; quoted in the Philosophical Magazine, No. 52.

‡ Journal of the Franklin Institute of America, quoted in Jameson's Journal, No. 43.

uncertain in its existence and source, but to a distinct and decided power, such as that possessed by iron and nickel; and my impression has been that there was a certain temperature for each body, (well known in the case of iron,) beneath which it was magnetic, but above which it lost all power; and that, further, there was some relation between this point of temperature, and the intensity of magnetic force which the body when reduced beneath it could acquire. In this view, iron and nickel were not considered as exceptions from the metals generally, with regard to magnetism, any more than mercury could be considered as an exception from this class of bodies as to liquefaction.

I took occasion during the very cold weather of December last, to make some experiments on this point. Pieces of various metals, in their pure state, were supported at the ends of fine platinum wires, and then cooled to a very low degree by the evaporation of sulphurous acid. They were then brought close to one end of the needles of a delicate astatic arrangement, and the magnetic state judged of by the absence or presence of attractive forces. The whole apparatus was in an atmosphere of about 25° Fahr.: the pieces of metal when tried were always far below the freezing point of mercury, and, as judged, generally at from 60° to 70° Fahr. below zero.

The metals tried were:—

Arsenic,	Lead,
Antimony,	Mercury,
Bismuth,	Palladium,
Cadmium	Platinum,
Cobalt,	Silver,
Chromium,	Tin,
Copper,	Zinc,
Gold.	

and also Plumbago; but in none of these cases could I obtain the least indication of magnetism.

Cobalt and chromium are said to be both magnetic metals. I cannot find that either of them is so, in its pure state, at any temperatures. When the property was present in specimens supposed to be pure, I have traced it to iron or nickel.

The step which we can make downwards in temperature is, however, so small, as compared to the changes we can produce in the opposite direction, that negative results of the kind here stated could scarcely be allowed to have much weight in deciding the question under examination, although, unfortunately, they cut off all but two metals from actual comparison. Still, as the only experimental course left open, I proceeded to compare, roughly, iron and nickel with respect to the points of temperature at which they ceased to be magnetic. In this respect iron is well known.* It loses all magnetic properties at an

* See Barlow on the Magnetic Condition of Hot Iron, Phil. Trans. 1822, p. 117, &c.

orange heat, and is then, to a magnet, just like a piece of copper, silver, or any other unmagnetic metal. It does not intercept the magnetic influence between a magnet and a piece of cold iron or a needle If moved across magnetic curves, a magneto-electric current is produced within it exactly as in other cases. The point at which iron loses and gains its magnetic force appears to be very definite, for the power comes on suddenly and fully in small masses by a small diminution of temperature; and as suddenly disappears upon a small elevation, at that degree.

With nickel I found, as I expected, that the point at which it lost its magnetic relations was very much lower than with iron, but equally defined and distinct. If heated and then cooled, it remained unmagnetic long after it had fallen below a heat visible in the dark: and, in fact, almond oil can bear and communicate that temperature which can render nickel indifferent to a magnet. By a few experiments with the thermometer it appeared that the demagnetising temperature for nickel is about 630° or 640°. A slight change about this point would either give or take away the full magnetic power of the metal.

Thus the experiments, as far as they go, justify the opinion advanced at the commencement of this paper, that all metals have similar magnetic relations, but that there is a certain temperature for each beneath which it is magnetic in the manner of iron or nickel, and above which it cannot exhibit this property. This magnetic capability, like volatility or fusibility, must depend upon some peculiar relation or condition of the particles of the body; and the striking difference between the necessary temperatures for iron and nickel appears to me to render it far more philosophical to allow that magnetic capability is a general property of all metals, a certain temperature being the essential condition for the developement of this state, than to suppose that iron and nickel possess a physical property which is denied to all the other substances of the class.

An opinion has been entertained with regard to iron, that the heat which takes away its magnetic property acts somehow within it and amongst its electrical currents (upon which the magnetism is considered as depending), as flame and heat of a similar intensity act upon conductors charged with ordinary electricity. The difference of temperature necessary for iron and nickel is against this opinion, and the view I take of the whole is still more strongly opposed to it.

The close relation of electric and magnetic phenomena led me to think it probable, that the sudden change of condition with respect to the magnetism of iron and nickel at certain temperatures, might also affect, in some degree, their conducting power for electricity in its ordinary form; but I could not, in such trials as I made, discover this to be the case with iron. At the same time, although sufficiently exact to indicate a great change

in conduction, they were not delicate enough to render evident any small change; which yet, if it occurred, might be of great importance in illustrating the peculiarity of magnetic action under these circumstances, and might even elucidate its general nature.

Before concluding this short paper, I may describe a few results of magnetic action, which, though not directly concerned in the argument above, are connected generally with the subject.* Wishing to know what relation that temperature which could take from a magnet its power over soft iron, had to that which could take from soft iron or steel its power relative to a magnet, I gradually raised the temperature of a magnet, and found that when scarcely at the boiling point of almond oil it lost its polarity rather suddenly, and then acted with a magnet as cold soft iron: it required to be raised to a full orange heat before it lost its power as soft iron. Hence the force of the steel to retain that condition of its particles which renders it a permanent magnet, gives way to heat at a far lower temperature than that which is necessary to prevent its particles assuming the same state by the inductive action of a neighbouring magnet. Hence at one temperature its particles can of themselves retain a permanent state; whilst at a higher temperature, that state, though it can be induced from without, will continue only as long as the inductive action lasts; and at a still higher temperature, all capability of assuming this condition is lost.

The temperature at which polarity was destroyed appeared to vary with the hardness and condition of the steel.

Fragments of loadstone of very high power were then experimented with. These preserved their polarity at higher temperatures than the steel magnet; the heat of boiling oil was not sufficient to injure it. Just below visible ignition in the dark they lost their polarity, but from that to a temperature a little higher, being very dull ignition, they acted as soft iron would do, and then suddenly lost that power also. Thus the loadstone retained its polarity longer than the steel magnet, but lost its capability of becoming a magnet by induction much sooner. When magnetic polarity was given to it by contact with a magnet, it retained this power up to the same degree of temperature as that at which it held its first and natural magnetism.

A very ingenious magnetizing process, in which electro-magnets and a high temperature are used, has been proposed lately by M. Aimé.† I am not acquainted with the actual results of this process, but it would appear probable that the temperature which decides the existence of the polarity, and above which all seems at liberty in the bar, is that required. Hence, probably,

* See on this subject, Christie on Effects of Temperature, &c., Phil. Trans. 1825, p. 62, &c.

† Annales de Chimie et de Physique, tome lvii., p. 442.

it will be found that a white heat is not more advantageous in the process than a temperature just above or about that of boiling oil; whilst the latter would be much more convenient in practice. The only theoretical reason for commencing at high temperatures, would be to include both the hardening and the polarizing degrees in the same process; but it appears doubtful whether these are so connected as to give any advantage in practice, however advantageous it may be to commence the process above the depolarizing temperature.*

THE ACTION OF ISINGLASS IN CLEARING MALT LIQUOR EXPLAINED.

By Mr. Samuel Roberts.

In explaining the action of isinglass in clearing malt liquor, two subjects present themselves for particular consideration.

The first is the nature and properties of isinglass. The second is the change which takes place in malt liquor during the process of fermentation.

The best isinglass is obtained from the sounds of the fish of the genus Accipenser, especially from the sturgeon, found in the Danube, and the rivers of Muscovy. It is also obtained from the sounds of the Beluga, and Huso Germanorum.†

Isinglass is almost entirely gelatine, 98 parts in every 100 of good isinglass being soluble in boiling water.

The properties of gelatine must therefore be considered, it being analogous to pure isinglass.

Gelatine is distinguished from all animal principles, by its ready solubility in boiling water, and also in most of the diluted acids, which form excellent solvents for it.

Gelatine is perfectly insoluble in alcohol, and almost equally so in cold water. It is precipitated from its solutions by infusions of tannin.

An infusion or tincture of galls, will precipitate it from its solution in 5,000 times its weight of water.

These are briefly the properties of gelatine, or pure isinglass, which should be borne in mind in operating on it

A great variety of isinglass is offered for sale, at a range of prices, from three to sixteen shillings per pound; and the relative value of each kind may be known by the following tests:

In the first place, isinglass should remain unchanged by being steeped in spirit of wine or alcohol, from 50° to 60° over proof, in which gelatine (the chemical principle of isinglass) is insoluble. The alcohol, or spirit of wine, in which the isinglass has been steeped, should then be tried with a few drops of tincture

* Philosophical Magazine, No. 46.

† Very pure isinglass is also procured from the American fish, *Gadus merluccius.* The long stripes of isinglass met with in commerce, are from the *Gadus morrhua.* See Thomson's Records of Science, vol. i., 239.

of galls; if the liquor remain clear and unchanged, it is much in favour of the character of the isinglass. If, on the other hand, the tincture of galls causes a precipitate from the alcoholic liquor, the isinglass is not pure, as it contains something more than pure gelatine.

Different samples of isinglass which have remained unchanged in alcohol or spirit of wine, should also be tried by the two following methods, before an opinion can be given as to their relative value. Try given weights of each sample (one-eighth of an ounce, for instance, in three ounces of water by measure) in separate vessels; bring them gradually to a boil, occasionally stirring each sample. While hot, strain the different solutions through muslin, into separate vessels. In proportion to the quantity of undissolved matter left upon each strainer, may the solubility of the different samples be ascertained; that which leaves the least residuum will form, when cold, the strongest jelly, upon which the clearing property of isinglass depends. The remaining trial to which the different samples are to be submitted, is the last and most decisive one. Equal weights of each sample (the one-fourth of an ounce, for instance,) are to be cut into very small pieces, and each one-fourth of an ounce put into half a pint, (imperial measure,) of hard or sour beer, and the several vessels containing the different samples put into an apartment, at from 65° to 75° F., and allowed to remain there for three days, stirring each sample very well, once or twice a day.

At the expiration of that time, there will be an evident difference in the strength of each jelly, provided different qualities of isinglass had been submitted to the experiment, and when the thickest jelly has a small quantity of the tincture of galls applied to it, and stirred through it, it will separate the gelatine from the sample of isinglass in the form of a thick jelly. The other samples which afforded a less solid jelly, will give, with tincture of galls, when stirred through it, a smaller quantity of gelatine in the form of thick jelly.

From the strength of the jelly given, by any sample of isinglass steeped in the above proportion of sour beer, (such as brewers use in making clearings,) and submitted to a temperature not exceeding 75° F., may be ascertained the relative value of that sample, as upon the strength of the jelly, and, consequently, the quantity of gelatine contained in any isinglass, depends its value in clearing malt liquor. The best short-staple isinglass is always soluble in boiling water to about 1-50th residue.

In the preparation of brewers' clearings, isinglass, of a good quality, is steeped in acid beer, in an apartment of about 50° F. temperature. After some time, the isinglass is converted into a jelly by the acidity of the hard beer, it being one of the qualities of gelatine to be soluble in dilute acids.

An advantage arises to the brewer, in always making his

clearings from sour beer of an uniform strength of acidity, by which means he is protected from any disappointment resulting from the strength of the clearings he uses, provided he was previously aware of the good quality of the isinglass he submitted to the action of the sour beer.

A simple method may be taken to try the acidity of malt liquor, of which a brewer intends to make clearings. Make a standard liquor of one part (by weight) of the bi-carbonate of potash, dissolved in sixteen parts (by measure) of water.

Suppose, for example, that sixteen fluid ounces of the acid porter to be tried, is put into a vessel that will contain about double that quantity.

Carefully measure a given portion of the standard liquor (say four fluid ounces). Add small quantities of this standard liquor to the acid porter, stirring the mixture upon every addition, until the effervescence ceases, or until the mixture is so neutralized by the standard liquor, as not to change the colour of litmus paper when it is dipped in. The mixture may further be tried by turmeric paper, which should be changed to a higher colour by the mixture, thereby showing that the alkali of the standard liquor is slightly in excess.—By the quantity of standard liquor required to produce this result, may be known the greater or less degree of acidity of the porter to be used for making clearings.

Sixteen fluid ounces of acid porter, such as is used by one of the largest breweries in Ireland for making clearings, standing 1° Twaddle's hydrometer, 61° F. temperature, required four fluid ounces of standard liquor to neutralize it, which is equal to 1 part bi-carbonate of potash to 64 parts of acid porter.

This appears a good average strength of acidity for porter, when required for making clearings. If acid porter required less standard liquor to neutralize it than the above quantity, it would indicate a weakness of acidity, which would render such porter an imperfect solvent for isinglass.

Acid porter, such as the above trial was made with, acts upon isinglass, at 61° F., but its action is much facilitated by an increase of temperature of 80° or 90° F.

During the fermentation of malt liquor, the saccharine matter of the malt is gradually converted into alcohol, by the agency of yeast and atmospheric air; ultimately the liquor passes from the vinous into the acetous fermentation.

This latter state is prevented by the exclusion of atmospheric air; hence, the necessity of bunging securely malt liquor, when the vinous fermentation is complete, otherwise the liquor will become sour.

It is when unfined porter is put into casks, and the vinous fermentation has, either in part or entirely, ceased, that brewers apply the clearings to the best advantage. The manner in which isinglass acts upon unfined liquor in clearing or fining it, is by two properties of gelatine (the chemical principle of isin-

glass.) First, its solubility in weak or dilute acids; and, secondly, by being perfectly insoluble in alcohol, and sparingly soluble in cold water.

When clearings, or isinglass, in combination with sour or acid beer, is applied to malt liquor in a state of vinous fermentation, the alcohol of the liquor disengages the gelatine of the isinglass from its solution in the acid porter, and, being thus liberated, it carries with it the impurities of the liquor which were suspended in it.

The following experiments will better illustrate the theory:

Mix a small quantity of brewers' clearings with cold water. In a short time the greatest part of the isinglass will be separated.

Filter the mixture through paper, and if a few drops of tincture of galls be added to the filtered liquor, a small portion of gelatine will be precipitated.

This shows that the acid of the clearings held a small quantity of the gelatine in solution. This is further proved by adding to the filtered solution as above, a few drops of liquor of ammonia, instead of tincture of galls. The liquor of ammonia should be cautiously added in sufficient quantity, to neutralize the acid contained in the clearings, when the gelatine, which was previously held in solution by the acid, is liberated.

By this experiment is shown, the solubility of isinglass in acid porter, and nearly its total insolubility in cold water.

Again, dilute a small quantity of clearings with cold water, until its acidity is so far overcome, as not to redden litmus paper, when applied to it. The isinglass of the clearings will be completely separated from the mixture; for, if a few drops of the tincture of galls be added to the filtered solution, it will remain unchanged.

Add warm water, at about 180° F., to another small portion of clearings, until the liquor is so much diluted as not to affect litmus paper when dipped in it, as in the previous experiment. Filter the liquor through paper, when cold. Gelatine will be detected in this solution by adding a few drops of tincture of galls. This shows the solubility of isinglass in hot water.

The next experiments will more clearly show the influence of alcohol in separating gelatine from its solution in weak acid, by which its action in clearing porter in a state of vinous fermentation, is explained.

To sixty parts of cold water, add one part of alcohol, and into this mixture put a small quantity of clearings.

In a short time the isinglass will be separated from the mixture, and the liquor will be clear and bright.

If, however, the liquor be filtered, and a few drops of tincture of galls be added to the filtered solution, a small portion of gelatine will be disengaged.

This is caused by the free acid of the sour porter, of which the clearings are made, holding this small portion of gelatine in so-

lution, as it may likewise be separated by adding a few drops of liquor of ammonia, instead of tincture of galls.

Reverse the experiment by using hot water at 180° F., instead of cold, adding the same quantity of alcohol and clearings, as in the former experiment.

After the mixture has been allowed to settle for a few hours, it will be found that there is but a partial separation of the isinglass, and the liquor will not be so clear as in the former trial, the reason of which is, that the hot water dissolves, and retains in solution a portion of the isinglass of the clearings, the remaining part being separated by the alcohol, in which it is insoluble. The effect would be exactly similar upon malt liquor, if clearings were applied to it which had been made with an excess of acid beer. The alcohol of the unfined porter would disengage but a small portion of isinglass from the clearings, the remainder being held in solution by the excess of acid in the porter, the disengaged gelatine carrying with it particles of vegetable matter, which, when suspended in the liquor, rendered it but semitransparent.*

FORMATION OF ÆTHER.

By M. Mitscherlich.

THE decomposition of alcohol into æther and water is not interesting merely by the production of æther, but is especially so as an example of a particular kind of decomposition, which cannot be so well followed with any other substance, and which is manifested in the formation of some important products, for example, in that of alcohol itself. M. Mitscherlich has endeavoured to elucidate the phænomena of this decomposition by the following experiments:—Take a mixture of 100 parts of sulphuric acid, 20 of water, and 50 of anhydrous alcohol, and heat it gradually until its boiling point becomes 284° Fahr. Alcohol is then allowed to fall gradually into the vessel which contains the mixture, and the current is to be so regulated that the heat of the mixture remains constantly at 284°. If, for example, the operation be conducted with a mixture of 6 ounces of sulphuric acid, 1 ounce and 1-5th of water, and three of alcohol, and if the density of each 2 ounces of product as it is obtained be taken, it will be observed that this density passes gradually from 0·780 to 0·788 and 0·798, and afterwards remains constantly at the last mentioned density, which is exactly that of the alcohol employed. If the operation be properly conducted, an unlimited quantity of alcohol may be converted into æther, provided that the sulphuric acid does not change. The distilled liquor is formed of two distinct fluids; the upper one is æther, containing a little water and alcohol; the lower one is water, with a little alcohol and æther. Its weight

* Thomson's Records, No. 14.

is nearly equal to that of the alcohol employed, and it is composed of

Æther	65
Alcohol	18
Water	17—100

If into 6 ounces of concentrated sulphuric acid 6 ounces of pure alcohol are suffered to flow gradually, a product of constant density is not obtained until the sulphuric acid has taken its proportion of water. Take, on the contrary, 3 ounces of sulphuric acid and 2 ounces of water, and let alcohol be added, drop by drop; the first 2 ounces distilled are merely spirit, if wine of specific gravity 0·926, containing scarcely a trace of æther. The density decreases until the quantity of water of the sulphuric acid is reduced to its proportion, and the product of the distillation has acquired the density of the alcohol.

If concentrated sulphuric acid be added to anhydrous alcohol in excess, pure alcohol distils at first; but when the temperature reaches nearly 260°, the first traces of æther begin to appear; the production of æther is at its maximum between 284° and 302°.

It results, from the preceding observations, that alcohol, when in contact with sulphuric acid, is converted into æther and water at a temperature of about 284°. A great number of analogous decompositions and combinations are known, which may be attributed entirely to the influence of the contact of bodies. The most remarkable example of this kind is that of the conversion of oxygenated water into water and oxygen, by the slightest trace of the peroxide of manganese and some other substances. The decomposition of sugar into alcohol and carbonic acid, the oxidizement of alcohol when it is changed into vinegar, are phænomena of the same kind; and so also is the conversion of starch and sugar by means of sulphuric acid. M. Mitscherlich, observing that in the preparation of carbureted hydrogen by means of sulphuric acid and alcohol water is formed at the same time, attributes this decomposition of alcohol to the influence of mere contact, and not to the affinity of sulphuric acid for water.*

METHOD OF COLOURING ORNAMENTS OF GOLD.

MANUFACTURERS possess a number of receipts for colouring ornaments, but the following is most commonly employed: 2 parts of saltpetre are mixed with 1 part of sea-salt and 1 part of Roman alum, in a quantity of this mixture equivalent to about three times the weight of the ornaments to be coloured, dissolved in boiling water so as to form a very concentrated solution where the ornaments are placed. This solution is called the sauce. Here they

* Journal de Pharmacie, Juin, 1835, quoted in the Philosophical Magazine, No. 46.

remain at a boiling temperature for 15 or 25 minutes, according to the shade to be given them; they are then washed in pure water and the operation terminates. If lustre is required, they are afterwards burnished; their weight is diminished about 1-16. The sauce takes up some copper, silver, and a certain quantity of gold; it is preserved for the purpose of extracting these metals. After it has been used, it takes the name of colour water. When allowed to stand at rest, it becomes limped, and a white deposit separates, called deposite of the colour waters, and the supernatant liquor is termed clear waters. Sulphate of iron is added to the clear waters, and then bars of iron are plunged into them. A precipitate containing gold falls down, called black matters. The white deposit, consists of water 10·6; soluble salts 48·8; insoluble matter 39·8=99·4. The insoluble portion contains, sub-alum 71·8; proto-chloride of copper 5·0; chloride of silver 8·5; oxide of iron 14·; metallic gold ·776=100·076. The black matters consist of, water 13·1; soluble salts 44·5; insoluble matter 41·8. The insoluble matter contained oxide of iron 64·; oxide of copper 26·; metallic gold 5·08; metallic silver 1·12=96·2. The assayers fuse the black matters with a mixture of potash, pearlash and borax to extract the gold and silver. The composition of the deposit from the colour waters, shows that in the action which the mixture of salts exercises upon the alloy plunged in the boiling sauce, the alum is decomposed, and abandons sulphate of potash and a great part of its sulphuric acid, to be transformed into a double insoluble sub-salt. The sulphuric acid which the potash loses, is taken up by the potash of the nitre, and by the sodium of the sea salt, converted into soda by the agency of the nitric acid set at liberty.

By the process described then, the concentrated colour water dissolves a portion of the gold at the temperature of ebullition; the metal remains in the liquid in the state of chloride, and a deposit of sub-alum takes place. The silver is still more strongly attached and is converted into chloride, and if the proportion of marine salt is sufficient, this chloride dissolves like the gold, but on cooling, a portion separates, and if the liquor is much diluted with water, the remainder precipitates and the solution only retains slight traces.*†

EXPERIMENTAL AND PHYSICAL RESEARCHES IN ELECTRICITY AND MAGNETISM.

By the Rev. William Ritchie, LL.D., F.R.S.

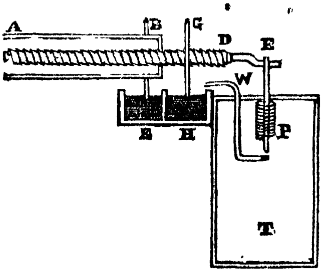
1. As soon as the magneto-electric spark and shock were obtained, it must have been observed that the *size* of the *spark* increased with the length of the coil employed, and afterwards diminished

* Annales de Chimie, lx.

† Thomson's Records, No. 16.

till it at length disappeared. The physiological effects are also exceedingly feeble with a short coil, and continue to *increase* by increasing the length of the wire long after the spark has attained its maximum brightness. In experimental research, and particularly in public lectures, it is very convenient to obtain both effects from the same magnet and revolving lifter. This is easily and expeditiously accomplished by the following arrangement, which will be understood by simply inspecting the annexed figure.

A B is the hollow axis, C D the solid axis passing through the former, metallic contact being prevented by a cylinder of wood. B is the disc of copper or platina dipping into the mercury contained in the cell F, and G the star or point dipping into the cell H. Two copper wires having their ends formed into a close spiral by rolling them round a thick wire, are soldered to the hollow and solid axis at B and C. The revolving lifter of soft iron is considerably longer than those commonly employed, and made of a tube of iron instead of a solid mass. A continuous coil of eighty or a hundred yards, or even more, according to the effect intended to be produced, is rolled about one of the ends, whilst two or three coils of thirty, forty, or fifty yards long are rolled about the other end. The ends of the last are collected together and soldered to a thick wire which fits into the cylinder formed by the spiral, each end of the single coil being terminated by similar pieces.



When brilliant phænomena of light are required, we fix a star of platina foil on the solid axis, and if we wish to double the effect we fix another similar star on the hollow axis, and connect the ends of the compound coil with the two axes by means of the spiral cylinder. If we wish to exhibit chemical or physiological effects we connect the continuous coil, or employ both coils as a continuous one.

When the short coil is employed the light is exceedingly brilliant and the shock scarcely sensible; with the long coil the light is feeble, but the shock unpleasantly powerful, even without wetting the hands.

The following simple addition to the revolving lifter will supersede the apparatus which I formerly described for detonating a mixture of oxygen and hydrogen by the magneto-electric spark. D E is a thick copper or brass wire, about the size of a quill, and bent into the annexed form. It is screwed into the end of the brass axis so as to have good metallic contact. E P is a wire

having a loop at E through which the wire passes, the other end resting on a small disc of copper connected with the wire W. T is a glass tube open at the lower end and closed at the other by a sound cork, or a piece of wood cemented in it. The wire W dips into the interior compartment F of the cup for holding mercury. A small spiral spring is fixed on the wire a little above P in order to secure good contact with the disc of copper. When the lifter is made to revolve, the end of the wire is raised from the disc at every revolution, and a brilliant spark appears at the point P, which will detonate a mixture of oxygen and hydrogen introduced into the tube.

Though these facts, which I have endeavoured to illustrate by an improved apparatus, are generally known, I am not aware that any theory has been proposed to account for the striking difference between the physical and the chemical or physiological effects.

The undulatory theory of light is already established on so firm a basis, that we may employ it in the explanation of all phænomena in which light is in any way evolved. It is universally admitted that *nothing* passes from the permanent magnet to the lifter when temporary magnetism is induced on the latter. It is also admitted that *nothing* passes from the lifter to its surrounding coil when *voltaic* electricity is induced on the latter. The polarity of the electricity essentially belonging to the soft iron is rapidly changed by the change of poles in the soft iron horseshoe lifter. The electricity thus thrown into a rapid vibratory state must derange the *stable* equilibrium of the electricity belonging to the coil of copper wire. Hence if this wire or the circuit be suddenly broken, which is the case when one of the points leaves the mercury, the rapid motion of the electricity at the point of separation must communicate a corresponding rapid vibration to the electric fluid contained in the surrounding air, and consequently to the electric fluid contained in the humours of the eye, retina, optic nerve, and brain, which will be followed by the sensation of the light.

The appearance and indefinite continuance of the magneto-electric light, without deriving supply from any foreign source, thus affords a powerful argument in favour of the undulatory theory of light, whilst it appears to me an unanswerable objection to the Newtonian doctrine. As long as the lifter is made to revolve, light of the same degree of brilliancy continues to emanate. We can conceive this motion continued for *ever*; so that the light, according to the Newtonian theory, lurking in a small copper wire and actually given out, would ultimately surpass all the light which has been given out by the sun since the creation of the world. For an infinite number of sparks, however minute, will constitute an infinite light; whereas the whole light given out by the sun since the creation is only a very limited quantity. Since gold-leaf placed in the circuit is deflagrated, and a fine

platina wire heated read hot, these effects are obviously produced by the rapid vibration of the *electricity* or *æther* essentially belonging to them. The metals then are obviously *heated* by their *own* heat, an unanswerable argument against the *chemical* theory of *caloric*.

2. In order to account for the production of the physical and physiological effects by wires of different lengths, we must take into view the striking difference between good and imperfect conductors of voltaic electricity. The metals not only conduct much *better* than liquids, but also convey the vibratory wave much *quicker*. In the case of a short conductor the whole electricity belonging to it has polarity induced on it in an indefinitely short period; and also returns to its natural state with extreme rapidity. To produce a sensation the exciting cause must continue to act for a certain length of time depending on the delicacy of the organ. The eye being the most delicate is affected by a series of vibrations continuing during a very short period: and hence a comparatively short wire formed into a coil will exhibit light when the circuit is broken before any sensible shock is experienced.

By continuing to lengthen the coil, the series of vibrations will continue during a longer period, but they may not follow each other with sufficient rapidity to constitute light. When any part of the body is placed in the circuit when the metallic contact is broken, the electricity belonging to that part of the body is suddenly forced into a corresponding polar arrangement accompanied by that peculiar sensation termed a shock. Hence in the case of five or six feet of imperfectly conducting substances, such as the liquids of the body, a certain length of time must be required to allow the induction to take place.

3. If these views be correct, the electric fluid instead of being an imponderable agent possesses one of the essential properties of ponderable matter. When a body is put in motion it will *communicate* a portion of its motion to other matter, but not without *losing* a corresponding quantity of its own motion. Hence, agreeably to the experiments of Mr. Faraday, when the electricity of one wire is forced to induce electric polarity on that belonging to another wire, the momentum of the first suffers a corresponding reduction. Again, the *motion* of the electricity of a wire towards a state of polarity will continue after the inducing cause has been removed, thus exhibiting in another point of view the same property of ponderable matter, viz., the inertia of matter, or in this case its tendency to continue in motion after the impulse which first produced the motion had ceased.

If these views be correct we have no right to expect that bodies at different temperatures, or differently electrified or magnetized, will have different weights, since in each of these states they contain exactly the same quantity of *ponderable* and improperly called im*ponderable* matter.

It is a well known fact that we receive a more powerful shock when electricity is being induced on the body than when the induced electricity is returning to its natural state. This is what might be expected from considering the energy and quantity of the exciting agents employed, these being either a powerful voltaic battery, or the immense quantity of electricity put in rapid motion in a large mass of soft iron.

If these views be correct again, it is obvious that as we *hear* by means of *vibrations*, so we see by means of *vibrations*, we are *warmed* by means of *vibrations*, and we receive an electric shock by the sudden *vibrations* excited in the elastic fluid essentially belonging to our own bodies.*

NOTICE OF CARBURET OF POTASSIUM, AND OF A NEW GASEOUS BI-CARBURET OF HYDROGEN.

By Edmund Davy, Esq., Professor of Chemistry to the Royal Dublin Society.†

In January last, the author made different experiments to obtain the metal of potash on a large scale, by exposing to a high temperature, in an iron bottle, a mixture of previously ignited tartar and charcoal powder, in proportions of the latter varying from about 1-10th to 1-15th of the whole mass.

In one experiment, a substance was obtained of a dark grey colour, rather soft to the knife, though adhering with tenacity to the iron, and inclining to a granular structure. This substance, when put into water, decomposes it with great facility, carbonaceous matter is disengaged, and gas copiously evolved, with occasional inflammations on the surface, as is commonly the case with potassium under similar circumstances. The gas, when examined, was found to consist of hydrogen, and a new bi-carburet of hydrogen, (noticed in a subsequent part of this communication,) in nearly equal volumes. The author regards the substance in question as a mixture of potassium and carburet of potassium; the former, by its action on water furnishing the hydrogen, the latter, the new gas. In collecting gas from the substance, by the action of water over mercury, a novel and interesting case of combustion was observed. A little of the substance being placed in a tube filled with mercury, on letting up a few drops of water, gas was copiously disengaged, and as the mercury descended along the tube, small portions of the substance became ignited, exhibiting the appearance of bright sparks of fire in continued succession.

In another experiment with the iron bottle, the author procured no potassium, but a small quantity of a substance partly in powder, and partly in small lumps, of a dense black colour. This

* Philosophical Magazine, No. 49.

† Communicated to the British Association, August 26th, 1836.

substance the author regards as carburet of potassium. It exhibits no appearance of crystallization to the naked eye; but when viewed with a glass of high magnifying power, the author thinks he has observed congeries of exceedingly minute four-sided prisms, truncated at their solid angles. When the carburet is exposed to the air, it soon undergoes changes, oxygen and water appear to be absorbed, and caustic potash and carbon remain.

When the carburet is put into water, both substances are decomposed. one portion of the carbon unites with the hydrogen of the water to form the new bi-carburet of hydrogen, which is the only gaseous product, the remainder being disengaged, whilst the oxygen of the water and the potassium from potash.

Alcohol and turpentine act feebly on the carburet, acids strongly.

The carburet undergoes partial decomposition at a dull red heat in close vessels, potassium slowly rises from it, whilst the carbon remains of a deep and bright black colour.

The author regards the pure carburet as a binary compound of one proportion of carbon and one of potassium.

New Bi-carburet of Hydrogen.

This gas was obtained by the action of carburet of potassium on water. It is highly inflammable, and when kindled in contact with air, burns with a bright flame, apparently denser and of greater splendour than even olefiant gas. If the supply of air is limited, the combustion of the gas is accompanied with a copious deposition of carbon. When the new gas is brought in contact with chlorine gas instant explosion takes place, accompanied by a large red flame, and the deposition of much carbon, and these effects readily take place in the dark, and are, of course, quite independent of the action of the sun's rays or of light. The new gas may be kept over mercury for an indefinite time without undergoing any apparent change; but it is slowly absorbed by water. Recently boiled distilled water, when agitated in contact with the new gas, absorbs about its own volume of it; but, on heating the aqueous solution, the gas is evolved apparently unaltered. The gas is absorbed to a certain extent by, and blackens, sulphuric acid.

The new gas detonates powerfully with oxygen, especially when the latter forms three-fourths or more of the mixture, and the only products appear to be water and carbonic acid gas. It requires for its complete combustion $2\frac{1}{2}$ volumes of oxygen gas, two volumes of which are converted into carbonic acid gas, and the remaining half volume into water. From the author's analysis by different methods the new gas appears to be composed of one volume of hydrogen and two volumes of the vapour of carbon condensed into one volume. Its density is therefore less than that of olefiant gas by the weight of a volume of hydrogen equal to that of its own bulk. It is, in fact, a bi-carburet of hydrogen

composed of two proportions of carbon and one of hydrogen, and may be represented by the formula $C^2 + H$, or $2\,C + H$; and its constitution seems to differ from that of any other known gas.

From the brilliancy with which the new gas burns in contact with the atmosphere, the author thinks it is admirably adapted for producing artificial light, if it can be procured at a cheap rate.*

GASTRIC JUICE.

MONS. H. BRACONNOT considers the gastric juice obtained from dogs to be composed of

1st. Free hydrochloric acid in considerable quantity.
2nd. Hydrochlorate of ammonia.
3rd. Chloride of sodium in large quantity.
4th. Chloride of calcium.
5th. Chloride of iron.
6th. Chloride of potassium, a trace.
7th. Chloride of magnesium.
8th. A colourless and pungent oil.
9th. Animal matter soluble both in water and alcohol, in considerable quantity.
10th. Animal matter soluble in dilute alkalies.
11th. Animal matter soluble in water, but insoluble in alcohol; (the salivary matter of Gmelin.)
12th. Mucus.
13th. Phosphate of lime.

M. Blondelot has endeavoured to produce artificial digestions, at the temperature of the human body, by filling glass tubes, some with a mixture of bits of meat and gastric juice, and others with meat and water slightly acidulated with hydrochloric acid: in both cases the flesh preserved its primitive form and fibrous texture whilst quiescent, but by the slightest movement it was converted into a homogeneous mass precisely similar to chyme produced in the stomach.†

CHEMICAL RAYS OF THE SOLAR SPECTRUM

Extract of a Letter from Mrs. Somerville to M. Arago, detailing some Experiments concerning the Transmission of the Chemical Rays of the Solar Spectrum through different Media.

IN the account of the meeting of L'Academie des Sciences on the 21st of December, 1835, (Compte Rendu, p. 508,) it is stated that M. Arago, after having repeated what was most essential in

* Thomson's Records, No. 23.
† Journal de Pharmacie, Feb. 1836, quoted in the Philosophical Magazine, No. 52.

those experiments by which M. Melloni proves that the solar rays while preserving all their luminous properties, may be deprived of their calorific power, remarked, that there was another point of view in which the subject might be investigated. He said it would be important to inquire if the means employed by M. Melloni, or other analogous ones, would not enable us to deprive the solar rays of their chemical properties also; or, in other words, if, of the three properties which light possesses when it reaches us from the sun,—1st, That of illuminating; 2nd, That of heating; and 3rd, That of destroying or exciting chemical combination, we could not separate the latter two, and retain its simple illuminating power. This experiment, remarked M. Arago, would probably lead to curious results, and I last week almost yielded to the temptation of undertaking the investigation. But, as possibly M. Melloni may have himself thought of it, though quite silent about it in his memoir, I think I had better not prosecute the subjects till after consulting the learned Italian philosopher.

The motives which I had in 1835, said M. Arago, at the meeting of the Academy on the 17th of October, 1836, not to interfere in researches which so directly conducted M. Melloni to these beautiful discoveries, still exist. I shall, therefore, abstain from stating some results to which I have arrived concerning the absorption or interception of the chemical rays. Every one, however, will understand that the same reserve cannot be imposed upon Mrs. Somerville; and I cannot, therefore, withhold the interesting experiments of this illustrious lady from the Academy, and the public.

In my experiments, she remarks, I employ the chloride of silver, which Mr. Faraday was so kind as to prepare for me, and which, accordingly, was perfectly pure and white. It was liquid, and might be uniformly spread over paper. Although this substance is exceedingly sensible to the action of the chemical rays; yet, as we have no precise means of appreciating the changes of colour produced by their action, some uncertainty as to the result might remain were we to compare only those tints which differ but little from each other; but the results which I shall furnish on this occasion shall be chosen from among those which were in no degree doubtful.

A piece of glass, of a light pale green colour, which was perfectly transparent, and less than 1-20th of an inch in thickness, did not permit any of the chemical rays to pass; after exposure for half an hour to a very hot sun, the chloride of silver behind the glass exhibited no change of colour whatever.

I have repeated this experiment with many pieces of green glass, which differed both in their tint and thickness, and I have always found that they were all nearly impervious so far as the chemical rays were concerned, and even after they had been subjected for a much longer period than that above stated to the

solar influence. As M. Melloni has already found that glass of this colour arrests the most refrangible calorific rays, by associating his results with mine, we are led to conclude, that glass of this colour has the power of wholly intercepting the most refrangible portion of the solar spectrum.

Laminæ of mica, of a deep green colour, are also nearly impervious to the chemical rays; however, when they are very thin, and the solar action is continued for a very long time, then it appears that they do not completely arrest these rays. I fixed, with a little wax, to a sheet of paper which was covered over with the chloride of silver, a sheet of pale green mica from Vesuvius, the thickness of which was not more than the thirtieth of an inch, and I exposed the whole to the rays of a powerful sun; after a time the sheet of mica being removed, it was found that that part of the paper which it covered retained all its original whiteness, whilst the rest was wholly of a deep brown colour.

The same experiment has been tried with fine sheets of white mica. Six sheets of common white mica placed on each other did not intercept the chemical rays; the chloride of silver which they covered, at the end of an hour's exposure to the sun, had become quite brown. The same result was obtained after using a single plate of mica, which, however was still thicker than all the others put together. This substance does not appear to present any obstacle to the transmission of the calorific rays.

These experiments led me at first to suppose that all green substances possessed this property: but I very soon found that this would be drawing too hasty a conclusion; for, having shortly afterwards tried the experiment with a very large emerald, the green of which was very beautiful, though not very deep, and the thickness of which was at least 0·35 of an inch, I found that it readily transmitted the chemical rays. Thus, the matter which imparts the colour to the green emerald has no action on the chemical rays, whilst that which imparts the same colour to glass and mica has great influence over them.

Rock-salt, as might be expected, possesses in a high degree the faculty of transmitting the chemical rays. Glass, too, coloured violet with manganese, and very deep blue glass, such as is common in finger-glasses, likewise very readily transmit these rays. The alteration in the colour of the chloride of silver very speedily takes place in spite of the interposition of a plate of blue glass of the deepest tint, and nearly a quarter of an inch thick.

Among the various substances which I have tried in these experiments, rock-salt and white glass, as also the blue and violet-coloured glasses, are those which afford the maximum of permeability to the chemical rays; whilst the green shades of glass and mica present the minimum. Other bodies possess this property in intermediate degrees, and sometimes vary considerably, though the colour is nearly the same. Thus glass of a deep red colour

allows very few of the chemical rays to pass, whilst garnet, of an equally deep colour, allows nearly the whole of them to pass. The white topaz, as well as the blue, the blue pale beryl, the cyanite, the heavy spar, the amethyst, and various other substances, transmit the chemical rays with great facility; whilst the yellow beryl does not, so to speak, transmit them at all, and the brown tourmaline as well as the green, have the property in so slight a degree, that I have failed in my attempts to polarize the rays under these circumstances, though I believe it might not be impossible, if thinner plates were used than I had it in my power to employ. In concluding, I may observe, that I purpose shortly to resume the prosecution of the subject.*

DONIUM, A NEW METAL CONTAINED IN DAVIDSONITE.

This mineral was discovered by Dr. Davidson of Aberdeen, in a granite quarry in the neighbourhood of that city: it has been examined by Mr. Thomas Richardson, and he concludes that he has obtained from it a metal which differs from any previously known.

"From the alkaline and earthy bases, and from several of the metallic ones, it is eminently distinguished by the green precipitate which it gives with sulpho-hydrate of ammonia; while its solubility in the caustic alkalies, and in carbonate of ammonia, the light brown precipitate thrown down by sulphureted hydrogen, and the green given by sulpho-hydrate of ammonia, are amply sufficient to distinguish it from all the others.

"If this substance be considered as sufficiently distinct, which, from its characters, I think I am warranted to conclude, I shall propose to give it the name of *Donium*, being a convenient contraction of Aberdonia, the Latin name of Aberdeen, near which place Davidsonite occurs; for the suggestion of which name I am indebted to Dr. Thomson.

"The change of colour which the precipitates of this substance undergo, during the process of washing, appears to be owing to different degrees of oxidation; and with a view to determine, if possible the characters of the metal itself, as well as its degrees of oxidation, the following experiments were made:—

"A. Over a portion of the white oxide strongly heated to redness, in a green glass tube, a current of dry hydrogen gas was passed, for nearly an hour. The whole was converted into a slate-blue mass, while aqueous vapour was evolved at the end of the tube: 100 parts of the white powder, by this means, lost 16·34 of their weight.

"B. A portion of the buff oxide was treated in the same way, and the same slate-blue powder was obtained, with the evolution

* Jameson's Journal, No. 43.

of aqueous vapour: 100 parts of this oxide lost, by this process, 5·11 of their weight.

"The substance possessing the slate-blue colour exhibited the following characters:—

"1. When pounded in dry agate mortar, it appeared to assume a lustre, resembling the metallic.

"2. When heated to redness, it glowed like tinder, and became white.

"3. In dilute muriatic acid, it effervesced, and was converted into white powder.

"4. When placed in a charcoal crucible, properly inclosed, and heated strongly in a forge for half an hour, it was not altered.

"It seems probable, that the slate-blue substance consisted of metallic donium, but in a state of intimate division; while from the experiments made upon the oxides, upon which, however, for many reasons, great confidence cannot be placed, it would appear that the oxides are composed of

1. The Buff	94·89 Donium	+ 5·11 oxygen.
2. The White	83·66 Donium	+ 16·34 oxygen.

Or, that the white oxide contains thrice as much oxygen as the buff.

"Although circumstances do not permit of my continuing this investigation, I have reason to believe that it will not be laid aside, but that a more full account of this substance will shortly be given by an individual much more capable of performing the task."*

CONSTANT VOLTAIC BATTERY.

On May 6th, Professor Daniel, of King's College, exhibited his battery at the Royal Institution. He was led to construct this very beautiful apparatus, by following up the investigations of Davy and Faraday. He found that the protecting power of tin on copper sheathing, was due to a chemical action. Thus he placed a plate of silver in a solution of sulphate of copper; and on touching it with a fine-pointed rod of zinc, he found the copper deposited on it in a circular form, and in a regular manner; and, if the contact was kept up, the whole plate was supplied with a copper coating. The effect of protecting metals appeared, at first an objection to the chemical theory of electricity; but this experiment demonstrates its truth. To determine and measure the definite chemical action of electricity, Mr. Daniel has constructed a dissected battery. It consists of ten cylindrical glass vessels, which contain the fluid electrolytes; the two plates of metal are immersed in these fluids, each plate communicating below by means of a separate wire, which is made to perforate a glass

* Records of Science, June, 1836, quoted in the Philosophical Magazine, No. 52.

stopper closing the bottom of the cell, with a small quantity of mercury contained in a separate cup below the stopper. The plates consisted of amalgamated zinc and platinum; the electrolyte consisted of 100 water, and 2·25 sulph. acid. He found that by increasing the size of the platinum plates, the action was promoted, and that the zinc might be reduced to the size of a wire, with the same effect as when a plate was used. Iron answers in place of the platinum, but not instead of zinc. The dilute acid described, has little action on the amalgamated zinc, because the latter becomes speedily covered with bubbles of hydrogen, which mar its action.—When nitric acid is added, the plate is soon dissolved, without extricating any gas, in consequence of the elements of the nitric acid combining with the nascent hydrogen. Nascent hydrogen also deoxidates copper. To remove the hydrogen, he constructed the constant battery; which consists of a copper cylindrical vessel, containing in its axis, a membraneous tube formed of the œsophagus of an ox, in which is suspended a rod of zinc. Dilute acid is poured into the membraneous tube, by means of a funnel; and passes off by a syphon, communicating with the bottom. The space between the animal tube and the sides of the copper cylinder, is filled with a solution of sulphate of copper, and pieces of this salt, to keep the solution saturated. By this arrangement, the oxide deposited is removed as it is formed, by the syphon tube; and the hydrogen evolved from the surface of the copper, is absorbed. For, on completing the circuit, the electric current passes freely through the blue vitriol solution, and no hydrogen appears on the conductor; but the latter is covered with a coating of pure copper. The advantages of this battery are obvious; it may be kept for hours in action, with the same power, and is economical.*

LOCALITY OF NATIVE MERCURY.

M. DE BONNARD has communicated to the Philomathique Society of Paris, a notice by M. Alluaud, sen. of Limoges, respecting the mercury of Peyrat le-Chateau, department de la Haute-Vienne.

This metal is found in the native state in a disintegrated granite, which forms the esplanade of the ancient castle of Peyrat, on the side of the royal road from Figeac to Montargis. M. Alluaud describes the nature of the soil of the country, which is entirely formed of various kinds of granite passing into each other, as kaolen and gneiss, &c. On the esplanade of the castle of Peyrat, M. Ranque, in clearing the soil and digging the foundation of a house, found twelve pounds of native mercury, and other persons also found some, M. Alluaud having made several excavations and also examined the places, found the mercury disseminated

* Thompson's Records, No. 18.

in a fine grained granite, which was very quartzose, and the felspar was decomposed. The metal does not exist throughout the rock, but only in parts of it; no bed, vein, or fissure can be perceived. The metal has been found at several distinct places, far from each other and without any communication; this circumstance is unfavourable to the idea of an accidental infiltration from above, for in this case the metal would have occupied a circumscribed situation in some fissure of the rock.

Notwithstanding the singularity of this locality of native mercury in a primary rock which contains no indications of cinnabar, and difficult as it is to draw a conclusion from an isolated observation confined to the narrow space of a few feet, M. Alluaud does not hesitate to pronounce either that the mercury is disseminated in the rock in small masses, irregular both as to form and extent, and in this case that the deposit has been contemporaneous with the formation of the rock; or that it occupies fissures in the rock, which are now imperceptible, into which it was subsequently conveyed by sublimation from the interior of the earth.*

ECONOMICAL MODE OF FORMING HYPER-MANGANATE OF POTASH.

By William Gregory, M.D., F.R.S.E.

My process is a modification of that of Wöhler, who recommends to melt chlorate of potash along with caustic potash in a platinum crucible, and to add peroxide of manganese to the fused mass.

There are several objections to this process. In the first place, the melted mass froths up violently when the last portions of oxygen escape, so that we can only employ a small quantity of materials, even in a pretty large crucible. 2ndly. I find that with less than 1 atom of chlorate to 1 of each of the other ingredients, the mass cannot be kept fused, and, consequently, the mixture is imperfect. 3rdly. From the large proportion of chlorate employed, a corresponding quantity of chloride of potassium is left, which interferes with the subsequent purification of the hypermangate of potash; and, lastly, since 1 atom of chlorate of potash loses 6 of oxygen by heat, while 1 of binoxide of manganese requires only 1 of oxygen to convert it into manganic acid, (the change which occurs in this stage of the process,) we lose 5-6ths of the oxygen.

After many trials, I found the following process to answer remarkably well.

Take of binoxide of manganese, 132 parts, (3 atoms,) of fused potash 147 parts, (3 atoms,) chlorate of potash 124 parts, (1 atom.) Dissolve the potash in a very small quantity of water, and add to the solution the oxide and the salt, previously in fine powder. Mix intimately so as to form a thin paste, which dry up and pul-

* L'Institut, No. 160, quoted in the Philosophical Magazine, No. 52.

verize finely. Introduce the powder into a platinum crucible, (which may be filled, as there is neither melting nor frothing,) and expose the whole for half an hour to a very low red heat. By this the production of the green manganate of potash which had taken place to a considerable extent during the exsiccation, is completed; while any hyper-chlorate of potash which may have been formed is destroyed.

The green mass, a mixture of manganate of potash and chloride of potassium, is easily detached from the crucible. It is to be dissolved in a very large quantity of hot water, and when the solution has acquired a pure red colour, it is to be decanted from the hydrated binoxide, the formation of which accompanies the change of manganate into hyper-manganate of potash. The clear solution, evaporated rapidly until crystals appear, deposits on cooling a number of small crystals nearly black. These are to be washed with a little cold water, dissolved in a small quantity of hot water, and this solution, on cooling, yields crystals of the hyper-manganate of potash, chemically pure, and of ten $\frac{4}{5}$ of an inch long. They have a fine bronze colour, and metallic lustre, and their solution in water possesses the most superb purple colour. I have always obtained, by the above process, a quantity of crystals equal in weight to one-third of the oxide employed.

The mother liquids, on the addition of sugar, yield a large quantity of hydrated peroxide, which, with that separated by decantation, is very well adapted for a new operation.

In this process, while the chlorate is economized, and the quantity of hyper-manganate increased, that of the chloride of potassium is diminished, and only half of the oxygen is lost.

I have no doubt, that, if the green mass be dissolved in a small quantity of cold water, and the solution evaporated in vacuo, the green manganate of potash may be obtained with equal facility.

Where it is necessary to filter these solutions, as paper cannot be employed, I am in the habit of using a funnel, the throat of which is stopped with Asbestus, which answers the purpose perfectly.*

ON SOLID CARBONIC ACID.

M. Thilorier, in a letter to the Academie des Sciences of Paris, says:—"I have the honour of now announcing to the Academy that I have just finished a second memoir upon liquid carbonic acid, in which, after having successfully examined the different parts of this body, its specific gravity, which is so variable that, from 32° to 86° Fahr., it successively runs through the whole scale of densities from water to that of ethers; its dilatability, which is four times greater than that of air itself; its pressure and the

* Thomson's Records, No. 22.

weight of its vapour; its capillarity, and especially its compressibility, which is a thousand-fold greater than that of water, I have succeeded in determining in the most exact manner, the uniform and constant law which regulates all these phenomena, which at first view appear altogether independent of each other.

The Academy will, without doubt, learn with interest, that, by means of a very simple apparatus, I have succeeded in instantly producing, and economically, masses of solid carbonic acid weighing an ounce and an ounce and a quarter, and which the experimental chemists may beneficially employ. My first experiments on cold, which I have already presented to the Academy, were made by directing a stream of liquid carbonic acid upon the bulb of a thermometer, or on tubes which inclosed the different substances upon which the action of the cold was tried. This method had the serious inconvenience of wasting a great quantity of the liquid, and of leaving some uncertainty upon the maximum of the cold produced. The facility and abundance with which I now obtain the solid carbonic acid has supplied me with a method of experimenting which is infinitely preferable. The bulb of the thermometer having been introduced into the centre of a small mass of solid carbonic acid, at the end of one or two minutes the thermometer became stationary and stood at —194° Fahr. Some drops of ether and of alcohol poured upon the solid mass did not produce any appreciable difference less or more on the temperature. Ether forms a mixture which is half liquid, and of the consistence of melting snow; but alcohol, in combining with solid carbonic acid, congeals, and produces a hard, brilliant, and semi-transparent ice. This freezing of anhydrous alcohol only takes place in the act of mixture; when isolated, as in a silver tube, in the midst of a mass of solid carbonic acid, the alcohol undergoes no change whatever. The mixture of alcohol and solid carbonic acid begins to melt at—185° Fahr. and starting at this point, the temperature does not vary any more.

Thus we can obtain from this extreme limit a point as fixed as is supplied by that of melting ice. If, after having formed a small coppel of solid carbonic acid, we pour into it three or four drachms of mercury, it is seen to congeal in a few seconds, and to remain in this new condition so long as an atom of solid carbonic acid remains, that is to say, for twenty or thirty minutes when the weight of the coppel is from two to three drachms. I have already said that the addition of ether or alcohol did not augment the real degree of the cold, but, by giving the solid carbonic acid the power of moistening bodies, and of adhering more intimately to their surface, these substances much increase the frigerating effects. A piece of solid carbonic acid, on which some drops of ether or alcohol are poured, becomes capable of congealing fifteen or twenty times its weight of mercury. The promptitude with which it is converted into the solid state, the mass in which it is effected, and which may easily exceed half a pound, and its con-

tinuance in this new condition, which may be maintained as long as you like, with the single precaution of placing the metallic mass upon a base of solid carbonic acid, leads me to believe that this method of freezing mercury will henceforward be substituted for all those which have been previously employed."*

ACTION OF LIGHT UPON PLANTS.

In January, a paper was read by Dr. Daubeny, before the Royal Society, entitled "On the action of Light upon Plants, and of Plants upon the Atmosphere."

The objects of the experimental inquiries of which the author gives an account in this paper were, in the first place, to ascertain the extent of the influence of solar light in causing the leaves of plants to emit oxygen gas, and to decompose carbonic acid, when the plants were either immersed in water, or surrounded by atmospheric air. The plants subjected to the former mode of trial were *brassica oleracea*, *salicornia herbacea*, *fucus digitatus*, *tussilago hybrida*, *cochlearia armorica*, *mentha viridis*, *rheum rhaponticum*, *allium ursinum*, and several species of *gramineæ*. Geraniums were the only plants subjected to experiment while surrounded with atmospheric air. Comparative trials were made of the action on these plants of various kinds of coloured light, transmitted through tinted glass, of which the relative calorific, illuminating, and chemical powers had been previously ascertained; and the results of all the experiments are recorded in tables; but no general conclusion is deduced from them by the author. He next describes a few experiments which he made on beans, with a view to ascertain the influence of light on the secretion of the green matter of the leaves, or rather to determine whether the change of colour in the chromule is to be ascribed to this agent. The third object of his inquiries was the source of the irritability of the *mimosa pudica*, from which it appeared that light of a certain intensity is necessary for the maintenance of the healthy functions of this plant, and that when subjected to the action of the less luminous rays, notwithstanding their chemical influence, the plant lost its irritability quite as soon as when light was altogether excluded. He then examines the action of light in causing exhalation of moisture from the leaves; selecting dahlias, helianthuses, tree mallows, &c., as the subjects of experiment. The general tendency of the results obtained in this series is to show that the exhalation is, *cæteris paribus*, most abundant in proportion to the intensity of the light received by the plant. He also made various comparative trials of the quantity of water absorbed, under different circumstances, by the roots of plants, and chiefly of the *helianthus annuus*, *sagittaria sagittifolia*, and the *vine*. From the general tenor of the results

* Jameson's Journal, No. 43.

of these and the preceding experiments, he is inclined to infer that both the exhalation and the absorption of moisture in plants, as far as they depend on the influence of light, are affected in the greatest degree by the most luminous rays; that all the functions of the vegetable economy which are owing to the presence of this agent, follow, in this respect, the same law; and that in the vegetable, as well as in the animal kingdom, light acts in the character of a specific stimulus. The author found that the most intense artificial light that he could obtain from incandescent lime produced no sensible effect on plants.

The latter part of the paper is occupied by details of the experiments which the author made with a view to ascertain the action of plants upon the atmosphere, and more especially to determine the proportion that exists between the effects attributable to their action during the night and during the day; and also the proportion between the carbonic acid absorbed, and the oxygen evolved.

His experiments appear to show that at least 18 per cent. of oxygen may be added to the air confined in a jar by the influence of a plant contained within it. He also infers that the stage of vegetable life at which the function of purifying the air ceases, is that in which leaves cease to exist. The author shows that this function is performed both in dicotyledonous and in monocotyledonous plants, in evergreens as well as in those that are deciduous, in terrestrial and in aquatic plants, in the green parts of esculents as well as in ordinary leaves, in algæ and in ferns as well as in phanerogamous families. Professor Marcet has shown that it does not take place in fungi.*

CONSIDERATIONS RESPECTING A NEW POWER WHICH ACTS IN THE FORMATION OF ORGANIC BODIES.

By M. Berzelius.

WHEN new compounds are formed in unorganized substances in consequence of action between different bodies, it is the result of the mutual tendency of these bodies to comply, in a more perfect way, with their affinities. On the one hand, those substances whose affinities are the strongest combine; and, on the other, those which have the weaker affinities are expelled. Previous to the year 1800, it was not supposed that any other determinate causes of these phenomena existed, than the power of this affinity itself, along with heat, and, in some circumstances, light. At that date the influence of electricity was detected; and shortly afterwards we were led to confound the electrical agency over bodies with the chemical, and to consider affinity as nothing more than the manifestations of opposite electricities, heightened by light and heat. But still, even this system supplied no other

* Philosophical Magazine, No. 48.

means of explaining the origin of new compounds than the supposition that, by the approximation of bodies thus put into contact, the electrical influence succeeded in more completely neutralizing them.

Starting with these views, which are deduced from the effects which occur in unorganized bodies, and then studying the chemical actions which organized bodies present, we observe that in the organs of these latter the most different kinds of products are elaborated, notwithstanding that the matter whence they all proceed consists in general only of one identical liquid, circulating in the vessels with more or less velocity. The vessels of the animal body, for example, without interruption, receive blood from the heart, and, nevertheless, at their extremities secrete milk, bile, &c. without the admission of any other liquid which is capable, in the way of double affinity, of affecting any decomposition whatever. There is clearly here a fact, of which the science of unorganized matter can give no explanation.

At this epoch M. Kirckhoff, discovered that starch, dissolved in a diluted acid, is transformed, at a certain temperature, first into gum, and then into sugar. It was then inquired, according to the prevailing views with respect to effects of this kind, what that substance was which the acid had taken from the starch in reducing it into sugar; but it was found that no gas had escaped, as the acid reappeared, by means of alkalies, in its original quantity; that no new combination had been formed; and that the liquid contained nothing else than sugar, in quantity equal, and even superior, to the quantity of the starch employed. The cause, then, of this change was as problematical as that of the secretions in organized bodies.

M. Thénard soon afterwards discovered the peroxide of hydrogen, a liquid whose elements are very feebly retained together. Upon this substance acids produce no change; but alkalies, on the contrary, occasion a tendency to decomposition, a species, in short, of fermentation, in which, of consequence, there is a separation of oxygen, and water remains behind. But what is peculiarly interesting is, that the same effect is produced not only by the action of such bodies as are soluble in this liquid, but also of various solid bodies, some organized and others unorganized; as, for example, by the peroxide of manganese, silver, platina, gold, and even by the fibrine of blood. The substance which produces the decomposition undergoes no alteration; nor does it become an element of the new compound, and therefore it operates by an inherent power, which, though unknown as to its essence, is, nevertheless, demonstrated by its effects.

Shortly before this discovery of M. Thénard, Sir H. Davy had noticed a phenomenon, the connexion of which with the preceding was not immediately recognised. He had proved that platinum, heated to a certain extent, and brought into contact with a

mixture of the vapour of alcohol, or of ether, and atmospheric air, possessed the power of producing the combination of these bodies, whilst other substances, such as gold and silver, had not this property.

A short time after this, Mr. E. Davy found that a preparation of platinum in a state of extreme mechanical division had the power, at ordinary temperatures, and after being moistened with alcohol, of becoming incandescent by the combustion of alcohol, at the same time changing this liquid by oxidation into acetic acid.

After this followed the discovery of Döbereiner, which was the most important of them all. He demonstrated the property which spongy platinum has of setting fire spontaneously to a current of hydrogen gas projected into atmospheric air; a phenomenon which the researches of Thenard and Dulong extended to many other bodies, both simple and compound, but with this restriction, that, whilst platinum, iridium, and some other metals of similar character, acted at temperatures below 32° Fahr., those other bodies, such as gold, and still more silver, required much higher temperatures, and glass a heat of 300° or more.

Thus, this property, which at first was considered as acting in a way that was altogether singular, appeared to be a general property, though acting differently in relation to different bodies; and it became possible to deduce from it certain applications. We now know, for example, that, in the act of fermentation, in the transformation of sugar into alcohol and carbonic acid, the change which is effected by the insoluble substance which is called ferment or yeast, and which may be replaced, though with less certainty, by animal fibrine, by albumen, by cheesy matters, &c. &c. cannot be explained by any chemical action between sugar and yeast, and that no phenomenon in unorganized bodies approaches it so nearly as the action of platinum, of silver, and of fibrine, in the decomposition of the peroxide of hydrogen into oxygen and water. It was, therefore, only natural to suppose that the mode of acting of yeast was analogons.

The transformation of starch into sugar, by means of sulphuric acid, had not hitherto been arranged and connected with the preceding facts; nevertheless, the discovery of *diastase*, a substance which acts upon starch in a similar manner, but with much greater energy, directed attention to this analogy; and the parallel was completely demonstrated to our satisfaction by the ingenious researches of M. Mitscherlich regarding the formation of ether. Among the many theories respecting the formation of ether, one as is well known, made the power of the sulphuric acid to transform the alcohol into ether to depend upon its power of combining with water, admitting that the alcohol, considered as a compound of 1 atom of etherine (C^4H^3) and 2 atoms of water, was converted into ether, by yielding the half of its water to the acid.

This theory, as simple as it was ingenious, was in perfect harmony with our knowledge of the actions of the affinities of bodies; but, notwithstanding, it did not explain why other non-acidulous bodies, as strongly disposed for water, did not also produce ether. The researches of M. Mitscherlich now prove that sulphuric acid, properly diluted, and taken at such a temperature that the refrigeration produced by the addition of the alcohol may compensate for the heat which is produced by the mixture, decomposed the former into ether and water, both of which, owing to the temperature surpassing the boiling point of water, separated themselves by distillation from the mass, and presented, when completely condensed, a mixture of the same weight with that of the alcohol employed. The method of operating in this experiment, as well as the fact of the distillation of the water conjointly with the alcohol, was, it is true, known before M. Mitscherlich, but to him belonged the merit of foreseeing the consequences. In a word, he demonstrated, that at this temperature the sulphuric acid acted upon the alcohol, in virtue of the same power which determines the action of alkalies upon oxygenated water, since the water, separating itself entirely from the mixture, had not obeyed any affinity for the acid; and he hence concluded, that the action of the sulphuric acid and the diastase upon starch, whence resulted sugar, must be of the same nature.

It is proved, therefore, that many substances, simple and compound, solid and in a state of solution, possess the power of exercising upon compound bodies an influence essentially distinct from chemical affinity, an influence which consists in the production of a displacement, and a new arrangement of their elements, without their directly and necessarily participating in it, some special cases only excepted. Assuredly such a power, which is capable of effecting chemical reactions in unorganized substances, as well as in organized bodies, although still too little known to be accurately explained, must play a far more important part throughout nature than we have hitherto been led to suppose. In defining it a new power, I am far from wishing to deny that some connexion exists between its influences and the electro-chemical ones, with which we are more familiar; on the contrary, I am very much disposed to recognise in it a peculiar manifestation of these same influences; but, notwithstanding, so long as we have not ascertained the real nature of this power, it will be more simple, so far as regards our future researches, to consider it as independent, and to confer upon it, for the facility of comprehension, a particular name. Accordingly, I shall designate it, thereby following a well known chemical etymology, the catalytic power of bodies; and the decomposition it produces I shall call catalysis, in the same way as we have designated by the term analysis, the separation of the elements of a compound, by means of the ordinary chemical affinities. This power seems

definitely to consist, in a faculty of bodies, by their simple presence, and without any chemical participation, to rouse up the play of certain affinities which at that temperature remained inactive, so as to determine, in consequence of a new arrangement of the elements of the compound, a new state of perfect electro-chemical neutralization. As this agent acts generally in a manner analogous to heat, it may be demanded, if being differently graduated, sometimes by a different mode of using the same catalytic body, sometimes by the introduction of different catalytic bodies in the same liquid, it would produce, as we often see in the action of different temperatures, different catalytic products; and if, on the other hand, the catalytic power of a body can exert itself upon a great number of compound bodies, or whether, as our experiments appear to indicate, only upon certain bodies, to the exception of others? But, in the present state of our knowledge, it is impossible to decide these questions, as well as many others which might be agitated on the subject; and their solution must be left for future research. It is sufficient, for the present, to have demonstrated the existence of this power by a number of examples; which power, as now explained, sheds a light altogether new upon chemical agency in organized bodies. We shall give only one example: round the eye of the potato we find a portion of diastase accumulated, which is totally wanting in the tuber itself, and in the developed germ: in this point we recognise a catalytic centre of action, in which the insoluble starch of the tuber is changed into gum and sugar; and this portion of the potato becomes the secreting organ of those soluble substances, which go to form the juices of the nascent germ. It is not at all likely that the action now mentioned should be the only one of its kind in vegetable life; on the other hand, we may decidedly presume that in vegetables, as well as in the animal body, a thousand catalytic effects take place between the solids and the fluids, whence really result the great number of different chemical compounds, whose production at the expense of the same physical fluid which we call blood, or vegetable juice, is to be explained by no other known cause.*

DESCRIPTION OF A THERMOMETER FOR DETERMINING MINUTE DIFFERENCES OF TEMPERATURE.

By Marshall Hall, M.D., F.R.S., &c.

In pursuit of the theory of the inverse ratio of the respiration and of the irritability in the animal kingdom, announced in a late volume of the Philosophical Transactions, I have found it absolutely necessary to determine the minute differences of tempera-

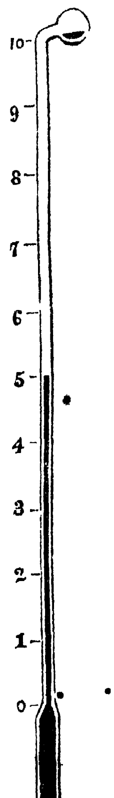
* From Jahrbuch fur 1836.—Von H. C. Schumacher, Berzelius, Bessel, Gauss, Moser, Olbers, and Pauckér. Stuttgart, 1836; quoted in Jameson's Journal, No. 42.

ture which exist in animals of the same class. In pursuing this inquiry, I soon discovered that it was essential to devise other instruments than those in ordinary use.

It was easy by enlarging the bulb and by selecting a tube of extremely fine calibre, to render the common thermometer capable of more minute indications. But it was impossible to carry this change beyond a certain degree, the augmented length of the instrument becoming highly inconvenient.

In order to obviate this difficulty, I devised the instrument which I am now about to describe.

The form of this instrument is represented in the accompanying outline. The relative size of the bulb and calibre of the tube is such that the tenth part of a degree occupies a considerable space upon the scale. The entire scale consists of ten degrees. At the upper part of the thermometric tube a small bulb is blown, which I shall designate the reservoir; it is turned forwards so as to remain at a right angle with the tube.



The bulb and the tube are filled with mercury, and a little of that fluid is included in the reservoir, when the whole is hermetically sealed.

When an experiment is to be made, the mercury in the tube is to be brought into contact with the mercury in the reservoir, by placing the instrument horizontally, with the reservoir upwards, in water of a sufficient temperature.

I will now suppose that I wish to try the comparative temperature of the swallow which shuns, and the sparrow which abides, the rigours of our winter. The thermometer is removed from the water at the temperature of 110° Fahr., and placed upright. The contiguity of the mercury in the tube with the mercury in the reservoir being broken, the highest point in the scale will represent that degree, viz., 110°. The lowest will consequently be the 100th degree. The entire scale is one of six degrees between these extremes, each degree being divided into tenths.

The same plan is adopted for any other part of the scale.

We have thus an instrument of the usual size, capable of measuring the tenths of a degree of temperature, at any part of the scale. It only requires the addition of a common thermometer to afford the extreme limit of the magnified scale.

I may be permitted to add, that the temperature of an animal indicated by such a thermometer compared with that of the me-

dium in which it is placed, affords a near approximation to the degree of respiration, and, inversely, of the irritability of the muscular fibre.*

CHEMICAL ANALYSIS OF TABASHEER.

By Thomas Thomson, M.D., F.R.S., L. & E., &c.

HAVING lately received, from Calcutta, a very fine specimen of tabasheer, I was naturally induced to make a few experiments on its chemical constitution.

It is sufficiently known that tabasheer is a concretion met with occasionally in the joints of the bamboo; that it has been long employed in medicine, in Hindostan and the East; that it is very much esteemed; and, that it sells at a considerable price. The first good description of it was drawn up by Dr. Russel, and published in the Philosophical transactions, for 1790, page 273. The specimen, laid before the Royal Society, by Dr. Russel, was put into the hands of Mr. Smithson for chemical examination. A very minute, accurate, and complete set of experiments, by this acute and accomplished philosopher, was published in the Philosophical Transactions, for 1791, page 368, from which it appeared, that the tabasheer was composed of silica nearly in a state of purity.

In the year 1806, a specimen of tabasheer, from Peru, was put into the hands of Fourcroy and Vauquelin, by Humboldt and Bonpland. These chemists subjected it to analysis, extracted from it 70 per cent. of silica, together with a little lime, and concluded, (though it is not easy to see the evidence,) that the tabasheer, which they examined, was a compound of 70 parts of silica, and 30 parts of potash. But under the potash were included the vegetable matter which they showed it to contain, and also the water, the amount of which, they seem not to have thought of determining.

In 1819, a curious paper on the optical properties of tabasheer, was published in the Philosophical transactions, by Dr. Brewster. An abstract of this paper, together with several particulars, relative to the history and formation of the tabasheer, was inserted in the eighth volume of Dr. Brewster's Journal of science; and in the same volume, we have a chemical examination of the tabasheer, by Dr. Turner. This analysis agrees very nearly with that of Mr. Smithson, and renders the accuracy of the statement of the great quantity of potash, announced by Fourcroy and Vauquelin, rather doubtful.

1. The tabasheer which I examined, was a very beautiful looking substance, in small irregular fragments of a blueish white colour and pearly lustre, not unlike chalcedony in appearance, but much softer. For it was incapable of scratching calcareous spar, and only slightly scratched

* Philosophical Magazine, No. 43.

sulphate of lime. When put into water, it gives out a great deal of air with a kind of crackling noise, and imbibes a great deal of water.

I found its specific gravity, (taken without allowing time for the internal air to escape,) 1·9238. But, when by means of heat all the air bubbles had been driven off, the specific gravity was as high as 2·0824.

2. When ignited, it lost 4·87 per cent. of its weight. This loss consisted chiefly of water; but not entirely, for the tabasheer exhaled a peculiar odour, and, showed evidently, the existence of a small quantity of vegetable matter in it.

3. Ten grains of tabasheer reduced to a fine powder were digested in distilled water for 24 hours. The water when concentrated was tasteless; but slightly reddened vegetable blues. Being evaporated to dryness, greyish scales remained, weighing 0·6 gr. These scales being digested in muriatic acid, a little iron was dissolved, but the scales consisted almost entirely of silica. Thus, it appears, that the silica in the tabasheer is still soluble in water. I am disposed to consider, the reddening of vegetable blues in this case, as produced by the dissolved silica; at least, I did not succeed in finding any trace of any other acid substance. When the muriatic acid dissolved upon the scales was evaporated to dryness, a brown matter remained, which besides iron, contained also a trace of vegetable matter; but too small to admit of examination. It contained also a little lime and a little silica.

4. Ten grains of tabasheer reduced to a fine powder, were mixed with 24 grains of finely pounded fluor spar, and the whole was made into a thin magma by means of sulphuric acid. This mixture was exposed for some hours to the heat of the sand bath in a platinum crucible. After the exhalations of fluosilicic acid had ceased, the crucible was exposed to a heat gradually increased to redness, and kept in that temperature till all the excess of sulphuric acid had been driven off. The white matter in the crucible, (chiefly of lime,) was now lixiviated with water, till every thing soluble was taken up. The water thus employed, was mixed with some carbonate of ammonia, and filtered to separate the lime which it had dissolved in the state of sulphate. The water, thus nearly freed from lime, was reduced to a small quantity, by evaporation, and, while still hot, was mixed with a few drops of solution of oxalate of ammonia, to throw down a little lime which had either escaped the action of the carbonate of ammonia, or had been afterwards supplied by the filter. The mixture was allowed to stand till it became clear, the liquid was then drawn off with a sucker, evaporated to dryness, and the saline residue exposed to a red heat. A salt remained, which weighed 0·2 grains, and which proved, on examination, to be sulphate of potash, equivalent to 0·11 grain potash.

5. Ten grains of tabasheer in the state of a fine powder were intimately mixed with 20 grains of anhydrous carbonate of soda, and the mixture exposed in a platinum crucible to a red heat, raised at last sufficiently high to bring the whole into a state of fusion. The colour of the fused mass was yellowish brown. It was dissolved in muriatic acid, the solution evaporated to dryness, and the residue, after being digested a sufficient time in muriatic acid, was thrown on the filter. The silica edulcorated, dried and ignited weighed 9 grains.

6. The muriatic acid, in which the silica had been digested being concentrated, was mixed with caustic ammonia. Yellow flocks fell, which were separated by decantation: these flocks, when ignited, became dark brown, and weighed 0·1 grain; they dissolved readily in muriatic acid.

The solution was super-saturated with caustic potash, and digested on the sand bath for 24 hours. By this means 0·01 grain of alumina was dissolved. The rest consisted of peroxide of iron. Thus, the yellow flocks thrown down by caustic ammonia consisted of

Peroxide of iron, ...	0·09
Alumina, ...	0·01
	0·1

The liquid from which this precipitate had fallen was not rendered muddy by carbonate of ammonia. It was, therefore, evaporated to dryness. A greyish matter remained weighing 0·08 grain. This matter being digested in muriatic acid, there remained undissolved 0·05 grain of silica. The 0·03 grain dissolved, consisted of a mixture of alumina and lime.

Thus, the constituents obtained were,

Moisture, ...	0·487 or	4·87
Silica, ...	9·050	90·50
Potash, ...	0·110	1·10
Peroxide of iron, ...	0·090	0·90
Alumina, ...	0·040	0·40
	9·777	97·77

The loss, amounting to 2·23 per cent., was probably the consequence of my employing different portions of the tabasheer in different steps of the analysis. For they were not all exactly the same in appearance. Hence, possibly the proportion of the constituents might vary somewhat in each. But my supply of tabasheer was not sufficiently great to admit of a new analysis upon a large scale. I did not weigh the lime; but do not think it could exceed 0·1 per cent. It is needless to observe, that the preceding analysis accords sufficiently with the experiments of Mr. Smithson and Dr. Turner, and, therefore, serves to confirm them. The tabasheer examined by Smithson, Turner, and myself was from India; that subjected to examination by Fourcroy and Vauquelin was from South America. It remains to be seen whether the constitution of the American tabasheer be essentially distinct from the Indian, as would appear from the 30 per cent. of the alkali, &c. found in it by Fourcroy and Vauquelin.*

ON THE COLOURS OF FLOWERS.

A CURIOUS essay on this subject, entitled "*Die farben der Blüthen,*" was published last year at Bonn, by Dr. Macquart, from which we extract the following abstract of the results obtained:—1. All flower leaves are originally green in the bud. 2. *Chlorophyll* contains no nitrogen. 3. All the tints of flowers are produced by two colouring matters. 4. These colouring matters are produced by the action of the living principle on *Chlorophyll.* 5. When water or its elements are removed from *Chlorophyll, Anthokyan* is formed. 6. *Anthokyan* is the colouring matter in

* Thomson's Records, No. 14.

blue, violet, and red flowers. 7. By the addition of water *Anthoxanthin* is formed from *Chlorophyll.* 8. *Anthoxanthin* is the colouring matter of yellow flowers. 9. Besides these two colouring matters we find in white, blue, red, and violet flowers, a flower resin, which may be regarded as the transition between *Chlorophyll* and *Anthokyan.* 10. There is also a slightly coloured extractive matter in white and yellow flowers, which is to be considered as the colourless sap of the cells. It is remarkable for its extreme sensibility in regard to alkalies, which colour it yellow. 11. The form of the cells has no influence on the production of a certain colour. 12. Orange-yellow flowers contain both colouring matters, *Anthoxanthin,* and *Anthokyan* which is reddened by acids. 13. Brown flowers contain *Chlorophyll,* and *Anthokyan* that is reddened by acids. 14. Flowers which contain both colouring matters produce *Anthokyan* in the epidermis and the upper layers of the cells, but *Anthoxanthin* in the interior of the cells. 15. *Anthokyan* is also the colouring matter of the other red leaf-like organs, but is in such cases covered by a colourless epidermis. 16. A black colouring matter does not exist in leaf-like organs; plants concentrate so much a blue, violet, or green tint that it seems to us a black. 17. The alteration of the colour of flowers must be observed with reference to the different periods of the life of the plants. 18. Yellow proceeds directly from green. 19. After the period of fructification, yellow passes frequently to the opposite range of colours. 20. All buds of red and blue flowers pass from green through white to red. 21. White is the transition step to blue. 22. Blue flowers are red in bud, because they have not begun to respire. 23. Some blue flowers become red and others white after the period of flowering. 24. The blue colour subsequently acquired by many red flowers may be explained in two modes.*

ON SILICIFIED FOSSILS.

On Jan. 22, at the Royal Institution, Dr. Faraday delivered an ingenious lecture upon this interesting subject.

Dr. Faraday began his observations on the conversion of ancient woods into siliceous matter, by detailing the characters of silica, its insolubility in acids when in a dry pulverulent state, and its ready solubility in water when fused with an alkali, alluding, in passing, to the method which we possess by means of fluor spar of obtaining it in an elastic, gaseous form. Whether it can be sublimed by the direct agency of heat seems doubtful. Dr. M'Culloch relates an experiment in which he exposed silica to a strong heat in a crucible, and apparently sublimed a portion. It is possible, however, that in this instance there might have been some fallacy. Dr. Faraday exhibited specimens of flint,

* Jameson's Journal, No. 43.

from the chalk, agates which may be considered a kind of siliceous nodules occurring in trap rocks, and a beautiful example of cap rock crystal to illustrate the deposition of the siliceous matter in layers. He showed also a fine amethyst containing colourless layers on its surface, which were thicker on some places than on others, and gave it as his conclusion drawn from an inspection of all the different forms of silica, that it had been deposited by one law because we find agates, chalcedony, rock crystal, and other forms, united in the same mass. The formation of chalcedony, he considers, cannot be accounted for by the mere drying of gelatinous silica, the contraction which would follow being too great to correspond with the forms in which we find chalcedony.

Silicified woods are found lying on the surface of siliceous and calcareous formations, as in Africa and Antigua. In some specimens we find that the soft parts of the wood yield first, and are replaced by silica, while in others, we observe the hard parts giving way and the soft parts remaining. In others again, both hard and soft portions have disappeared, and have been entirely replaced by silica. Specimens from Antigua exhibit trees silicified in all stages of decay. In one specimen which the lecturer showed, the exterior circles were silicified, and exhibited the vessels of the plant in perfect preservation, while the centre had been hollow and was filled up with agate. There is no evidence to prove that silicification has taken place in modern times. The effect produced by the Geyzers is merely incrustation, for the substances upon which the silica from these springs is deposited remain entire; silicification, however, consists in the displacement of organic matter by silica. Several instances have been related of the effect of rivers in silicifying or petrifying with silica, as of the waters of the Aar, Danube, and Loch Neagh; but the localities to which this power was assigned, when examined by competent authorities exhibited no such property. Specimens of what have been considered by some as silicified sugar canes were shown by Dr. Faraday, but the vessels in these specimens, as he was informed, were quite different from those of the recent sugar cane.

The examples which appear to be of the most recent formation, are some specimens from Loch Neagh, where fibrous portions of carbonaceous matter occur dispersed in different parts of silicified masses, and the silicified *Gorogonites*, or seeds of the *Chara hispida*, described by Mr. Lyell, from the lakes in Forfarshire.

In referring to the explanation of these curious phenomena, Dr. Faraday considered that the present state of our knowledge did not enable us to afford a solution of the difficulty, and that to form a theory would merely tend to embarass the subject, for such was the universal character of theories. It is impossible to admit that intense heat could have produced these changes, because Dr. M'Culloch asserts that *confervæ* exist in many specimens of rock crystal, which would have been destroyed if the matter in which

they lie inclosed had been exposed to a high temperature. The views of Dr. Turner, the lecturer considered, afforded an excellent explanation of the source of the silica. He exposed portions of crown and window glass to the action of steam in a high pressure boiler, the temperature being 300° F. In the course of 4 months, they were found to be more or less decomposed; the white earthy portions were found to be entirely free from alkaline matter, but the actual loss was not due to the extraction of the alkaline matter only, for the silica of the glass had also been dissolved, as was proved by the apertures of the wire gauze in which the glass was incased, being filled up at the most depending parts by a siliceous incrustation, where also a stalactitic deposit of silica about an inch and a quarter long had formed. Dr. Turner adduced these facts to illustrate the action of water at high pressure on felspar, and other rocks containing alkaline matters. Dr. Faraday considered these experiments as highly important in regard to affording a source for the silica, but conceived that we were still ignorant of the mode in which the silica is deposited in such a variety of forms. He stated that he had brought the subject before the meeting to stimulate to investigation respecting this interesting and beautiful phenomenon.

Note.—It may be observed, that excellent imitations of chalcedony can be produced, by allowing silica, in the gelatinous state, to dry on a filter in the open air. The following queries may not, perhaps, be out of place:—Is the opinion expressed by Dr. Faraday on the influence of theories altogether just? Have they not acted beneficially on the developement of electricity, optics, and chemistry? Does the explanation suggested by Dr. Turner apply to the solution of silica in any other situations than under great pressure, and consequently at a great depth, and at a temperature above the boiling point of water? If it does not, why should silicified wood occur only at the surface, and chiefly on siliceous and calcareous formations?*

ACCOUNT OF A METHOD OF SEPARATING SMALL QUANTITIES OF ARSENIC FROM SUBSTANCES WITH WHICH IT MAY BE MIXED.

By James Marsh, Esq., of the Royal Arsenal, Woolwich.†

NOTWITHSTANDING the improved methods that have of late been invented of detecting the presence of small quantities of arsenic in the food, in the contents of the stomach, and mixed with various other animal and vegetable matters, a process was still wanting for separating it expeditiously and commodiously, and presenting it in a pure unequivocal form for examination by the

* D. R. Thomson, in the Records of Science, No. 14.

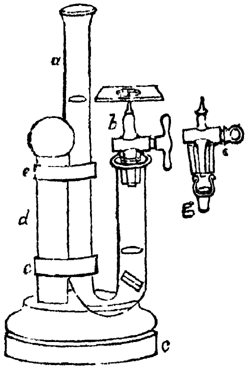
† The large gold medal of the Society of Arts of London, was presented to Mr. Marsh for the above valuable communication, which will appear in the 51st vol. of the Society's Transactions.

appropriate tests. Such a process should be capable of detecting arsenic not only in its usual state of white arsenic or arsenious acid, but likewise in that of arsenic acid, and of all the compound salts formed by the union of either of these acids with alkaline substances. It ought, also, to exhibit the arsenic in its reguline or metallic state, free from the ambiguity which is sometimes caused by the use of carbonaceous reducing fluxes. It appeared to me, that these objects might be attained by presenting to the arsenic, hydrogen gas in its nascent state; the first action of which would be to deoxygenate the arsenic; and the next, to combine with the arsenic, thus deoxygenated, into the well known gas called arsenuretted hydrogen. Being thus brought to the gaseous state, the arsenic would spontaneously (so to speak) separate itself from the liquor in which it was before dissolved, and might be collected for examination by means of any common gas apparatus; thus avoiding the trouble, difficulty, and ambiguity of clarification and other processes whereby liquors, suspected of containing arsenic, are prepared for the exhibition of the usual tests, or of evaporation and deflagration, which are sometimes had recourse to in order to separate the arsenic from the organic substances with which it may have been mixed.

I had the satisfaction of finding, on trial, that my anticipations were realized; and that I was thus able, not only to separate very minute quantities of arsenic from gruel, soup, porter, coffee, and other alimentary liquors, but that, by continuing the process a sufficient length of time, I could eliminate the whole of the arsenic in the state of arsenuretted hydrogen, either pure, or, at most, only mixed with an excess of hydrogen.

If this gas be set fire to as it issues from the end of a jet of fine bore into the common air, the hydrogen, as the more combustible ingredient, will burn first, and will produce aqueous vapour, while the arsenic will be deposited either in the metallic state, or in that of assenious acid, according as it is exposed partially or freely to the air. The former condition is brought about by holding a piece of cold window-glass opposite to and in contact with the flame, when a thin metallic film will be immediately deposited on its surface; and the latter, by receiving the flame within a glass tube open at both ends, which, in half a minute, will be found to be dimmed by a white pulverulent sublimate of arsenious acid. By directing the flame obliquely upon the inside of the tube, it strikes against the glass and deposits the arsenic, partly in the metallic state. In this case, if the tube, while still warm, be held to the nose, that peculiar odour, somewhat resembling garlic, which is one of the characteristic tests of arsenic, will be perceived. Arsenuretted hydrogen itself has precisely the same colour, but considerable caution should be used in smelling it, as every cubic inch contains about a quarter of a grain of arsenic.

The requisite apparatus is as simple as possible; being a glass tube open at both ends, and about three quarters of an inch in its internal diameter. It is bent into the form of a syphon, *a a*, the shorter leg being about five inches, and the longer about eight inches in length. A stop-cock, *b*, ending in a jet of fine bore, passes tightly through a hole made in the axis of a soft and sound cork, which fits air-tight into the opening of the lower bend of the tube, and may be further secured, if requisite, by a little common turpentine lute. To fix the apparatus, when in use, in an upright position, a hole is made in the wooden block *c* for the reception of the lower part of the pillar *d*, and a groove is cut in the top of the same block to receive the bend of the tube *a a*. Two elastic slips, *e e*, cut from the neck of a common bottle of India rubber, keep the tube firm in its place.



The matter to be submitted to examination, and supposed to contain arsenic, if not in the fluid state, such as pastry, pudding, or bread, &c., must be boiled with two or three fluid ounces of clean water, for a sufficient length of time.

The mixture so obtained must then be thrown on a filter to separate the more solid parts: thick soup, or the contents of the stomach, may be diluted with water and also filtered; but water-gruel, wine, spirits, or any kind of malt liquor, and such like, or tea, coffee, cocoa, &c., can be operated on without any previous process.

When the apparatus is to be used, a bit of glass rod, about an inch long, is to be dropped into the shorter leg, and this is to be followed by a piece of clean sheet zinc, about an inch and a half long and half an inch wide, bent double, so that it will run down the tube till it is stopped by the piece of glass rod first put in. The stop-cock and jet are now to be inserted, and the handle is to be turned so as to leave the cock open. The fluid to be examined, having been previously mixed with from a drachm and a half to three drachms of dilute sulphuric acid (1 acid and 7 water), is to be poured into the long leg, till it stands in the short one about a quarter of an inch below the bottom of the cork. Bubbles of gas will soon be seen to rise from the zinc, which are pure hydrogen, if no arsenic be present; but, if the liquor holds arsenic in any form in solution, the gas will be arsenuretted hydrogen. The first portions are to be allowed to escape, in order that they may carry with them the small quantity of common air left in the apparatus; after which the cock is

to be closed, and the gas will be found to accumulate in the shorter leg, driving the fluid up the longer one, till the liquor has descended in the short leg below the piece of zinc, when all further production of gas will cease. There is thus obtained a portion of gas subject to the pressure of a column of fluid of from seven to eight inches high: when, therefore, the stop-cock is opened, the gas will be propelled with some force through the jet, and, on igniting it as it issues (which must be done quickly by an assistant,) and then holding horizontally a piece of crown or window-glass, *f*, over it, in such a manner as to retard slightly the combustion, the arsenic (if any be present) will be found deposited in the metallic state on the glass; the oxygen of the atmosphere being employed in oxydizing the hydrogen only during the process. If no arsenic be present, then the jet of the flame as it issues has a very different appearance; and, although the glass becomes dulled in the first instance by the deposition of the newly formed water, yet, such is the heat produced, that in a few seconds it becomes perfectly clear, and frequently flies to pieces.

If the object be to obtain the arsenic in the form of arsenious acid, or white arsenic, then a glass tube, from a quarter to half an inch in diameter, (or according to the size of the jet of flame,) and eight or ten inches in length, is to be held vertically over the burning jet of gas, in such a manner that the gas may undergo perfect combustion, and that the arsenic combined with it may become sufficiently oxydized; the tube will thus, with proper care, become lined with arsenious acid, in proportion to the quantity originally contained in the mixture.

When the glass tube is held at an angle of about forty-five degrees over the jet of flame, three very good indications of the presence of arsenic may be obtained at one operation; viz., metallic arsenic will be found deposited in the tube at the part nearest where the flame impinges,—white arsenic, or arsenious acid, at a short distance from it,—and the garlic smell can be readily detected at either end of the tube in which the experiment has been made.

As the gas produced during the operation is consumed, the acid mixture falls into the short limb of the tube, and is thus again brought into contact with the zinc, in consequence of which a fresh supply is soon obtained. This gas, if submitted to either of the processes before described, will give fresh indications of the presence of the arsenic which the mixture may have originally contained; and it will be easily perceived that the process may be repeated as often as may be required, at the will of the operator, till no further proofs can be obtained.

When certain mixed or compound liquors are operated on in this apparatus, a great quantity of froth is thrown up into the tube, which may cause a little embarrassment by choking the jet. I have found this effect to take place most with the con-

tents of the stomach, with wine, porter, tea, coffee, or soup, and, indeed, with all mucilaginous and albuminous mixtures. The means I adopt to prevent this effect from taking place, or, at least, for checking it in a great measure, is to grease or oil the interior of the short limb of the apparatus before introducing the substance to be examined, or to put a few drops of alcohol or sweet oil on its surface previously to introducing the stop-cock and its appendages. I have, however, found, if the tube be ever so full of froth in the first instance, that, in an hour or two, if left to itself, the bubbles burst, and the interior of the tube becomes clear, without at all affecting the results.

In cases where only a small quantity of the matter to be examined can be obtained, I have found a great convenience in using the small glass bucket *g*. Under such circumstances, the bent glass tube may be filled up to within an inch of the short end with common water, so as to allow room for the glass bucket, which must be attached to the cork, &c. by means of a little platina wire; a bit or two of zinc is to be dropped into the bucket, with a small portion of the matter to be examined, and three or four drops of diluted sulphuric acid, (acid 2, water 14;) and the whole is then to be introduced into the mouth of the short limb of the tube. The production of gas under this arrangement is much slower, and, of course, requires more time to fill the tube, than in the former case; but the mode of operating is precisely the same. Indeed, it is of great advantage, when the quantity of arsenic present is very minute, not to allow the hydrogen to be evolved too quickly, in order to give it time to take up the arsenic.

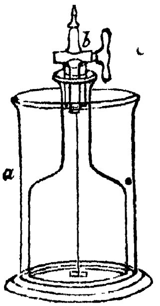
A slender glass funnel will be found of service when as much as a table-spoonful, or even a tea spoonful, of matter can be obtained for examination. In this case, the tube is to be partly filled with common water, leaving a sufficient space for the substance to be examined; a piece of zinc is to be suspended from the cork by a thread or wire, so as to hang in the axis of the tube; and the fluid to be operated on, having previously been mixed with dilute sulphuric acid, is then to be poured through the funnel carefully, so as to surround the zinc, avoiding, as far as possible, to mix it with the water below, and the stop-cock and its appendages are to be replaced in the mouth of the tube; the production of the gas then goes on as before stated, and the mode of manipulating with it is exactly the same as described in the foregoing part of this paper.

It will be necessary for me, in this place, to explain the methods I employ after each operation, to determine the integrity of the instrument, so as to satisfy myself that no arsenic remains adhering to the inside of the tube, or to the cork and its appendages, before I employ it for another operation.

After washing the apparatus with clean water, a piece of zinc

may be dropped in, and the tube filled to within half an inch of the top of the short limb; two drachms of diluted sulphuric acid are then poured in, and the stop-cock and cork secured in its place; hydrogen gas will, in this case, as before, be liberated, and fill the tube. If the gas, as it issues from the jet, be then inflamed, and a piece of window-glass held over it as before described, and any arsenic remains, it will be rendered evident by being deposited on the glass; if so, this operation must be repeated till the glass remains perfectly clean, after having been exposed to the action of the gas.

When I have had an opportunity of working with so large a quantity of mixture as from two to four pints, (imperial measure,) I then have employed the instrument here figured, which is, indeed, but a slight modification of one of the instantaneous light appearances, now so well known and used for obtaining fire by the aid of a stream of hydrogen gas thrown on spongy platinum.



It will, therefore, be of importance only for me to describe the alteration which I make when I employ it for the purpose of detecting arsenic. In the first place, I must observe, that the outer vessel, *a*, which I use, holds full four pints, and that the jet of the stop-cock is vertical, and its orifice is twice or three times larger than in the instrument as generally made for sale, and also that there is a thread or wire attached to the cork of the stop-cock *b*, for suspending a piece of zinc, *c*, within the bell-glass.

With an instrument of this description, I have operated on one grain of arsenic in twenty-eight thousand grains of water (or four imperial pints,) and have obtained therefrom upwards of one hundred distinct metallic arsenical crusts.

Similar results have been obtained with perfect success from three pints of very thick soup, the same quantity of port wine, porter, gruel, tea, coffee, &c. &c.

It must, however, be understood, that the process was allowed to proceed but slowly, and that it required several days before the mixture used ceased to give indication of the presence of arsenic, and, also, a much larger portion of zinc and sulphuric acid was employed from time to time, than when working with the small bent tube apparatus, in consequence of the large quantity of matter operated on under this arrangement.

With the small apparatus, I have obtained distinct metallic crusts, when operating on so small a quantity as one drop of Fowler's solution of arsenic, which only contains 1-120th part of a grain.

The presence of arsenic in artificial orpiment and realgar, in

Scheele's green, and in the sulphuret of antimony, may be readily shown by this process, when not more than half a grain of any of those compounds is employed.

In conclusion, I beg to remark, that although the instruments I have now finished describing, are the form I prefer to all that I have employed, yet it must be perfectly evident to any one, that many very simple arrangements might be contrived. Indeed, I may say unequivocally, that there is no town or village in which sulphuric acid and zinc can be obtained, but every house would furnish to the ingenious experimentalist ample means for his purpose; for, a two-ounce phial, with a cork and piece of tobacco-pipe, or a bladder, with the same arrangement fixed to its mouth, might, in cases of extreme necessity, be employed with success, as I have repeatedly done for this purpose.

The only ambiguity that can possibly arise in the mode of operating above described, arises from the circumstance, that some samples of the zinc of commerce themselves contain arsenic; and such, when acted on by dilute sulphuric acid, gave out arsenuretted hydrogen. It is, therefore, necessary for the operator to be certain of the purity of the zinc which he employs, and this is easily done by putting a bit of it into the apparatus, with only some dilute sulphuric acid; the gas thus obtained is to be set fire to as it issues from the jet; and if no metallic film is deposited on the bit of flat glass, and no white sublimate within the open tube, the zinc may be regarded as in a fit state for use.*

ANALYSIS OF TARTAR EMETIC.

By Mr. Thomas Richardson.

Dr. Phillip's analysis of this salt differing from Dr. Thomson's in the proportion of the water it contains, I was induced to repeat the experiments of the latter gentleman, employing the same specimen.

The analysis was conducted in the following manner:

1. Twenty-five grains were heated for a considerable time, on the sand bath, at the temperature of about 400° Fah., and lost 1·21 grs., or 4·84 per cent.

2. What remained was dissolved in water, and a current of sulphureted hydrogen passed through the solution till all the antimony was thrown down. The precipitate, after being well washed and dried, weighed 13·3 grains. But 11 sesquisulphuret of antimony : 8 antimony : : 13·3 : 9·67 grs. = 11·48 grs, oxide of antimony.

3. The liquid and washings from the above precipitate were carefully evaporated to dryness, and the residual salt weighed

* Jameson's Journal, No. 42.

13·23 grs. Knowing the composition of this salt or bitartrate of potash, we obtain the following result:

Oxide of antimony	..	..	45·92
Potash	..	..	12·80
Tartaric acid	..	..	35·25
Water	..	..	4·84
			98·81

Resolving these weights into atoms, we have for the constituents of the salt,

Oxide of antimony	..	..	4·83 =	2·26 atoms.
Potash	..	..	2·13 =	1·00
Tartaric acid	..	..	4·27 =	2·00
Water	..	..	4·30 =	2·01

The result of Dr. Thomson's analysis was,

1·997 atom tartaric acid.
1 92 atom protoxide of antimony.
1 atom potash.
2 139 atoms water.

The mean of the two analyses as below,

Oxide of antimony	..	..	2·12
Potash ..	..	..	1·00
Tartaric acid	..	..	1·96
Water ..	..	..	2·07

leaves no doubt as to the following being the true composition of the salt:

2 atoms oxide of antimony		..	19·00
1 atom potash ..	..	..	6·00
2 atoms tartaric acid	..	..	16·50
2 atoms water ..	..	..	2·25
			43·75*

MEMOIR ON THE CHEMICAL COMPOSITION OF ASSES' MILK.

By M. E. Péligot.†

THESE researches have been undertaken for the purpose of ascertaining whether the changes which are produced by asses' milk in the animal economy are owing to the differences in the proportion of the constituent elements of this liquid; and, supposing this conjecture to be verified, to determine the circumstances which influence the relative qualities of the proximate principles.

The method which M. Péligot followed consists in submit-

* Thomson's Records, No. 22.
† Read to the Academie des Sciences of Paris.

ting a certain quantity of milk, the volume and density of which was noted at the commencement, to the heat of a vapour-bath. When the residuum ceased to lose more by evaporation, it was weighed; it was then treated with a mixture of alcohol and ether, which removed all the fatty matter; it was again subjected to heat and dried, and then weighed, and the difference of the two numbers gives the weight of the butter. Frequent washing with cold water separates the sugar of milk from the caseum, the quantity of which is then determined in the same way as was the greasy or oily matter.

The density of asses' milk varies from 1,030 to 1,035, water being 1,000. It is very nearly the same as cows' milk, which, however, contains a considerably greater quantity of solid matter. This result, which appears contradictory, is explained by the large quantity of butter in cows' milk compared with the other, which contributes to diminish the density.

Ass-milk differs much from other milks; owing especially to the great proportion of sugar of milk which it contains; and it is to the preponderance of this ingredient, according to M. Péligot, that we are probably to attribute its chief medicinal virtues.

As an average of sixteen analyses, the author finds that 100 parts of ass milk contains

		Butter	1·29
Solid matter	9·53*	Sugar of milk	6·29
Water	90·47	Caseum	1·95
	100·00		

* The proportion of the solid matter obtained varied from between 7 and 11 per cent. of the milk; it is sometimes, though rarely, under 7 per cent.

The composition of asses' milk may, like that of other milk, vary under the influence of different causes, and especially under that of nourishment. For the purpose of manifesting the effects produced by this last cause, the same ass was fed with different kinds of nourishment for a continued time, and at the end of not less than a fortnight of this uniform regimen, its milk was submitted to analysis.

1st Experiment. An ass was fed for a month with carrots, freed from their leaves: at the end of this time its milk contained, in every 100 parts,

		Butter	1·25
Solid matter	8·89	Sugar of milk	6·62
Water	91·11	Caseum	1·62
	100·00		8·89

This milk, evaporated to dryness, appeared of an orange colour, and exhaled the smell of carrots. This ass ate 18 kilogrammes weight of carrots a-day, equal to 39 lb. 11 oz. 10 dr.

2nd Experiment. The same ass was then furnished with red beet-root; and, at the end of fifteen days, its milk showed the following composition:

Solid matter	.. 10·23 ..		Butter	1·39
			Sugar of milk ..	6·51
Water ..	.. 89·77 ..		Caseum	2·33
	100·00			10·23

This is the nourishment which made the milk most rich in solid matter. The ass ate 21 kilogrammes of beet in the day, equal to 46 lb. 5 oz. 9 dr.

3rd Experiment. To the same ass was given, for a month, 7 kilogrammes of bruised oats a-day, equal to 15 lb. 7 oz. 3 dr., and 3 kilogrammes of dry lucern, equal to 6 lb. 9 oz. 15 dr.; its milk, at the end of this time, contained

Solid matter	.. 9·37 ..		Butter	1·40
			Sugar of milk ..	6·42
Water ..	.. 90·63 ..		Caseum	1·55
	100·00			9·37

4th Experiment. The same ass was fed for a fortnight on potatoes, and its milk then supplied the following analysis:—

Solid matter	.. 9·29 ..		Butter	1·39
			Sugar of milk ..	6·70
Water ..	.. 90·71 ..		Caseum	1·20
	100·00			9·29

From these analyses we are led to conclude, that the beet-root is that nourishment which furnishes milk most rich in solid matter; next succeeds the mixture of lucern and oats; then the potatoes; and lastly, the carrots. M. Péligot, moreover, endeavoured to ascertain the different specific gravities of the milk procured under the different kinds of feeding. The weight was found greater according as the quantity of solid matter existing in the milk was greater. Thus there was collected, nine hours after the previous milking: When fed with

Beet	1·500 kil.	= 3 lb.	4 oz.	15·5 dr.	or 3·3 lb.
Oats and lucern	1·500	= 3	4	15·5	or 3·3
Potatoes ..	1·250	= 2	12	2·25	or 2·74
Carrots ..	1	= 2	3	5	or 2·2

I have mentioned, says M. Péligot, the time which elapsed since the previous milking, because it is one of those circumstances which has a great effect on the quantity of the principles discovered in the milk. That we might be able accurately to measure the influence of this cause, the following experiments were made. The milk of the same ass was collected an hour and a half after the previous milking, then after six hours had elapsed, and then when twenty-four hours had expired.

	After an hour and a half.	After 6 hours.	After 24 hours.
Butter ..	.. 1·55	1·40	1·23
Sugar of milk	.. 6·65	6·40	6·33
Caseum ..	.. 3·46	1·55	1·01
Solid matter	.. 11·66	9·37	8·57
Water ..	.. 88·34	90·63	91·43
	100·00	100·00	100·00

It will thus be seen that the proportion of solid matter became less, or, in other terms, the milk became less and less rich, in proportion as a long time elapsed after the last milking. As this result is directly contrary to the commonly received opinion, the author was apprehensive it might have been reached through some accidental means, or, perhaps, because the usual and proper limits in which the milk is secreted had been exceeded. He, therefore, instituted a new set of experiments, taking the milk at an interval of six hours, and twelve hours, after the former milking.

	Six hours after former milking.	Twelve hours after.
Butter ..	.. 1·73	1·51
Sugar of milk ..	.. 7·00	6·70
Caseum ..	.. 1·25	1·10
Solid matter ..	.. 9·98	9·31
Water ..	.. 90·02	90·69
	100·00	100·00

But, not only does the milk vary in its composition according to the greater or shorter time which elapses from the previous milking; the analysis presents, moreover, sensible differences according as it is taken from the early or late drawn portion of the same milking. Thus, when the milk drawn without interruption, and, of course, at the same milking, after an interval of nine hours from the former, is divided into three distinct portions, the following is the result:—

	First third.	Middle third.	Last third.
Butter ..	.. 0·96	1·02	1·52
Sugar of milk	.. 6·50	6·48	6·45
Caseum..	.. 1·76	1·95	2·95
Solid matter	.. 9·22	10·45	10·94
Water ..	.. 90·78	89·55	89·66
	100·00	100·00	100·00

Thus, in the same milking, the richest is that which is last procured, a fact in accordance with the universal opinion of those conversant with the concerns of the dairy; and also with the experiments of M. Deyeux, and of Parmentier on the proportion of butter contained in the different portions of the milk obtained on the same occasion.

In finishing his labours, M. Péligot endeavoured to ascertain if the introduction of certain mineral substances into the food of the animal passed into the circulation, and affected the milk. For ten days, thirty grains of the iodide of potassium was administered to an ass, and its milk was then submitted to analysis. After being evaporated to dryness, the residuum was heated in a platinum crucible: the part which was soluble in water, after being acidified by sulphuric acid, gave, by means of a solution of starch and chlorine, a very sensible tint of blue. This milk, therefore, contained iodide of potassium. Common salt, given at the rate of three ounces a-day, was recognised in the milk, by its flavour, and was also made apparent by analysis. Chlorine, given at the rate of five grains a-day, and to the extent of twelve grains, could not be traced in the milk; nor could it be discovered in that of a she-goat, which had taken the same quantities. Thirty grains of the bi-carbonate of soda were given, for six successive days, to an ass. At the end of this time, its milk was found highly alkaline the moment it was drawn,—the experiment being made upon fifteen different milks. Usually, the new drawn milk of the ass exhibits acid properties.*

ARTIFICIAL CRYSTALS AND MINERALS.

One of the most striking incidents of the late meeting of the British Association at Bristol, occurred in Section C., Geology and Geography, and is briefly reported as follows, in Professor Jameson's Journal:—

A. Crosse, Esq., of Broomfield, Somerset, came forward, and stated, that he came to Bristol to be a listener only, and with no idea he should be called upon to address a section. He was no geologist, and but little of a mineralogist; he had, however, devoted much of his time to electricity, and he had latterly been occupied in improvements in the voltaic power, by which he had succeeded in keeping it in full force for twelve months by water alone, rejecting acids entirely. Mr. C. then proceeded to state, that having observed in a cavern in the Quantock Hills near his residence, that part of it which consisted of slate was studded with crystals of arragonite, while the lime stone part was covered with crystals of calcareous spar, he subjected portions of each of these substances in water, to long continued galvanic action (ten days' action), and obtained from the slate crystals of arragonite, from the limestone crystals of calcareons spar. In order to ascertain if light had any influence in the process, he tried it again in a dark cellar, and produced similar crystals in six days, with one-fourth of the whole voltaic power. He had repeated the experiments a hundred times, and always with the same results. He was fully convinced that it was possible to make even

* Jameson's Journal, No. 43.

diamonds, and that at no distant period every kind of mineral would be formed by the ingenuity of man. By variations of his experiments he had obtained crystallized quartz, the blue and green carbonates of copper, chrysocolla, phosphate of copper, arseniate of copper, acicular carbonate of lead, sulphate of lead, sulphuret of iron, white antimony, and many other minerals.

Mr. Crosse then invited all who chose to visit his retreat in the Quantock Hills, where he would show them his apparatus and experiments. One of the first to accept this invitation was Sir Richard Phillips; a paper descriptive of whose visit was read at a recent *conversazione* of the Sussex Institution, at Brighton, and subsequently communicated by Sir Richard to the *Brighton Herald*. From this very interesting paper, the following is an extract:—

The originality of the circumstance (says Sir Richard), determined me at once to accept his invitation; and the day after that on which the business of the Association was finished, I proceeded to Bridgewater, from which Broomfield is distant about eight miles in the hill country. * * * Mr. Crosse then conducted me into a large and lofty apartment, built for a music-room, with a capital organ in the gallery; but I could look at nothing but the seven or eight tables which filled the area of the room, covered with extensive voltaic batteries of all forms, sizes, and extents. They resembled battalions of soldiers in exact rank and file, and seemed innumerable. They were in many forms; some in porcelain troughs of the usual construction, some like the *couronnes des tasses*, others cylindrical, some in pairs of glass vessels, with double metallic cylinders: besides these, others of glass jars, with stripes of copper and zinc. Altogether there were 500 voltaic pairs at work in this great room; and in other rooms about 500 more. There were, besides, other 500 ready for new experiments. It seemed like a great magazine for voltaic purposes. There are also two large workshops, with furnaces, tools, and implements of all descriptions, as much as would load two or three wagons. In the great room there is also a very large electrical machine, with a 20-inch cylinder, and a smaller one; and in several cases all the apparatus in perfect condition, as described in the best books on electricity. The prime conductor stood on glass legs, two feet high, and there was a medical discharger on a glass leg of five feet. Nothing could be in finer order; and no private electrician in the world could, perhaps, show a greater variety, both for experiments and amusement. Beneath the mahogany cover of a table, on which stood the prime conductor, &c., was inclosed a magnificent battery of 50 jars, comprising 73 square feet of coating. Its construction, by Cuthbertson, was in all respects most perfect. To charge it required 250 vigorous turns of the wheel, and its discharge made a report as loud as a blunderbuss. It fuses and disperses wires of various metals; and the walls of the apartment are covered

with framed impressions of the radiations from the explosion taken at sundry periods. Mr. Crosse struck one while I was present, and he has promised me one as an electrical curiosity, and a momento of my visit. But Mr. Crosse's greatest electrical curiosity, was his apparatus for measuring, collecting, and operating with, atmospheric electricity. He collects it by wires, of the 16th of an inch, extended from elevated poles to poles, or from trees to trees, in his grounds and park. The wires are insulated by means of glass tubes well contrived for the purpose. At present, he has about a quarter of a mile of wire spread abroad and in general about a third of a mile. The wires are connected with an apparatus in a window of his organ gallery, which may be detached at pleasure, when too violent, by simply turning an insulated lever; but in moderate strength, it may be conducted to a ball suspended over the great battery, which, connected with it, is charged rapidly, and is then discharged by means of an universal discharger. He told me that sometimes the current was so great as to charge, and discharge the great battery twenty times in a minute, with reports as loud as cannon, which, being continuous, were so terrible to strangers, that they always fled, while every one expected the destruction of himself and premises. He was, however, he said, used to it, and knew how to manage and control it; but when it got into a passion, he coolly turned his insulating lever, and conducted the lightning into the ground. It was a damp day, and we regretted that our courage could not be put to the test. Every thing about this part of Mr. Crosse's apparatus is perfect, and much of it his own contrivance, for he is clever in all mechanical arrangements, and has been unwearied in his application, almost night and day, for thirty years past. I learned, too, that in the purchase and fitting of his apparatus, he has expended nearly 3,000*l.*, although in most cases, he is his own manipulator, carpenter, smith, copper-smith, &c.

Next morning I took notes of every thing connected with his aqueous voltaic batteries in the following order, errors excepted:—

1. A battery of 102 pairs, of 25 square inches, charged like all the rest with water, operating on cups containing one ounce of carbonate of barytes and powdered sulphate of alumine, intended to form sulphate of barytes at the positive pole, and crystals of alumine at the negative.—2. A battery of 11 cylindrical pairs, 12 inches by 4. This, by operating 6 months on fluate of silver, had produced large hexhaedral crystals at the negative pole, and crystals of silica and chalcedony at the positive.—3. A battery of 100 pairs, of 4 square inches, operating on slate 832, and platina 3, to produce the hexagonal crystals at the positive pole.—4. A battery of 100 pairs, 5 inches square, operating on nitrate of silver and copper, to produce melachite at the positive pole; at the negative pole, crystals already appear with decided angles and facets.—5. A battery of 16 pairs, of 2 inches, in small glass jars,

acting on a weak solution of nitrate of silver, and already producing a compact vegetation of native silver.—6. A battery esteemed his best, of 813 pairs, 5 inches, insulated on glass plates on deal bars, coated with cement, and so slightly oxydated by water as to require cleaning but once or twice a year by pumping on them. I felt the effect of 458 pairs in careless order, and imperfectly liquidated, and they gave only some tinglings of the fingers; but this power, in a few weeks, produces decided effects. —7. A battery of 12 pairs, 25 inches zinc, and 36 copper, charged two months before with water, and acting on a solution of nitrate of silver, poured on green bottle-glass, coarsely powdered. It had already produced a vegetation of silver at the positive pole.—8. A battery of 159 galley-pots, with semicircular plates of 1½ inch radius, placed on glass plates, and acting for five months, through a small piece of Bridgewater porous brick, on a solution of silex and potash. I saw at the poles small crystals of quartz.—9. A battery of 30 pairs, similar to No. 8, acting since July 27, on a mixture, in a mortar, of sulphate of lead, of white oxide, of antimony, of sulphate of copper, and of green sulphate of iron, (205 grains,) and three times the whole of green bottle-glass (615 grains). The result has been, in five weeks, a precipitation, on the negative wire, of pure copper in two days, and crystallized iron pyrites in four days. It had been expected to produce sulphurets of lead, copper, and antimony, by depriving the sulphates of their oxygen On August 10th and 28th, 25 grains and 40 grains of sulphate of iron were added.—10. A battery of five jars, with plates of different metals, as two copper and platina, one of lead, and one silver and iron, and one copper and lead.—Experimental.—11, 12, and 13. About 200 pairs in three batteries, working in a dark room, of which I took no note.*

ON THE COMPARATIVE VALUE OF IRISH AND VIRGINIAN TOBACCO.

By Edmund Davy, F.R.S., M.R.I.A., &c.

In the year 1829-30 the cultivation of tobacco in Ireland excited much attention among agriculturalists, and several hundred acres of it were raised in different counties; in consequence, the attention of the Royal Dublin Society was directed to the subject, and the author was requested by a select committee of that body to institute experiments on tobacco with a view to determine some questions of a practical nature, as whether its root contained nicotin, and in what quantity, and to ascertain the comparative value of Irish and Virginian tobacco.

The author's experiments were made on average samples of Virginian and Irish tobacco; for the former he was indebted to the kindness of Mr. Simon Foot, and for the latter to Messrs. Wild, Cuthbert, Cathwell, and Brodigan. From a number of

* Quoted in the Mirror, No 802.

experiments, the author was led to conclude, that the dried roots of Irish tobacco contain from four to five parts of nicotin in 100 parts; and that one pound of good Virginian tobacco is equivalent in value to about twenty-four pounds of good Irish tobacco.

After the author had finished his experiments it was gratifying to him to be informed that some manufacturers estimate one pound of Virginian tobacco equivalent in value to about two pounds of Irish.*

ON SEVERAL NEW COMBINATIONS OF PLATINUM.

By J. W. Doebereiner.

THE cyanuret of potassium and platinum, produced according to the method of L. Gmelin, is known to form, with a solution of the acid protonitrate of mercury, a beautiful smalt-blue precipitate, with the disengagement of a small quantity of nitrous gas.

On a closer examination this precipitate affords several interesting appearances and new products, (cyanuret of mercury and platinum, cyanuret of platinum, and a compound of hydrocyanic acid and cyanurèt of platinum.) as well as the proof that platinum and cyanogen are mutually disposed to enter into very close combinations.

This precipitate may be washed with cold water acidulated by nitric acid and then dried, without suffering any alteration in its colour. But if boiled with this water, it yields protonitrate of mercury, and becomes quite white. If a solution of protonitrate of mercury be poured upon this white precipitate and left at rest on it at ordinary temperatures for several hours or longer, the precipitate gradually becomes as blue as it was at first; and after some days the intensity of this colour increases, if the nitrate of mercury remains in excess; if the precipitate be heated with the latter it remains white, but after the evaporation of the water of the nitrate of mercury, it becomes blue, and if the heat be increased, orange red.

When the blue and orange red precipitate is strongly heated on a piece of platinum foil, it detonates, giving out sparks and smoke, and flying on all sides like sky-rockets, with a hissing noise. It is dissolved in heated muriatic acid, with the formation of nitric acid and hydrocyanic acid, and forms a colourless solution which is not rendered turbid by alcohol nor precipitated by muriate of ammonia.

The white precipitate kindles when heated on platinum foil without detonating, burns away without flame, and leaves behind about 38 per cent. of spongy platinum, strongly disposed to ignition. Boiling muriatic acid dissolves it, but without developement of nitric or hydrocyanic acid, and forms an almost colour-

* Proceedings of the British Association: Lond. and Edinb. Phil. Mag., vol. vii. p. 391; quoted in the Repertory, No. 25.

less solution, which a solution of potash turns yellow, and which, on evaporation to dryness, gives a residue, appearing partly red, partly yellow, and partly blue, and this by a strong heat is decomposed into hydrocyanic acid, chloride of mercury, and cyanuret of platinum.

The solution of the alkalies and alkaline earths decompose the coloured and the bleached precipitates, and separate, from the first, protoxide and peroxide of mercury, from the latter, only peroxide; at the same time they leave their radical in combination with the cyanogen of the cyanuret of mercury, and in this combination form, with the cyanuret of platinum, easily crystallizable double cyanurets of platinum. When the white precipitate is gradually heated to redness in a glass retort, it is decomposed into cyanogen gas, fluid mercury, and cyanuret of platinum. The quantity of the latter is about 48 per cent., (4·8 grains from 10 grains on which I experimented,) we may therefore consider the white precipitate as a combination of

$$\left.\begin{array}{l}\text{48 Cyanuret of Platinum}\\ \text{52 Cyanuret of Mercury}\end{array}\right\} = \text{Pt Cy} + \text{Hy Cy, or Pt Hy Cy}_2.$$

and we may consider the blue (and red) precipitate as a combination of this double cyanuret with protonitrate of mercury. I have not yet examined in what relation these salts stand to one another, and whether the blue colour belongs to the whole combination or merely to one of its products (perhaps the oxide of platinum).

The cyanuret of platinum which remains after the pyro-chemical decomposition of the colourless cyanuret of platinum and mercury, is a fine olive-yellow pulverulent substance, insoluble in water, acids, or alkalies, combustible, and when burnt in the air leaving 78 to 79 per cent. of pure platinum, and when heated with oxide of copper in the pyro-pneumatic apparatus giving carbonic acid and nitrogen gases nearly in the proportion of 2 to 1; it therefore consists of one atom of platinum and one of cyanogen = Pt Cy.

If the cyanuret of mercury and platinum is diffused in water and treated with hydrosulphuric acid, we obtain sulphuret of mercury and a colourless fluid with a strong acid reaction, which contains, in solution, a combination of cyanuret of platinum with hydrocyanic acid. If we evaporate this liquid, this new combination presents itself as a greenish yellow substance, with a metallic lustre on the surface, partly gold, partly copper colour; it deliquesces in damp air, and is very easy of solution in water and absolute alcohol, and combines with the alkalies so as to form double cyanurets.

If this combination, which on account of its acid properties I shall call (*Cyanplatinwasserstoffsäure*) a compound of hydrocyanic acid and cyanuret of platinum (H Cy + Pt Cy), be dissolved in absolute alcohol, and this solution left in the open air to eva-

porate on a watch-glass or a plate of glass, the compound offers to the eye of the observer a peculiar crystallization, and at the same time an interesting but indescribable cameleon-like play of colours. If the dry acid be allowed to deliquesce in moist air and is then evaporated in dry air or in the sunshine, it crystallizes in exceedingly beautiful needles, grouped together like stars, which have a metallic lustre and are sometimes gold, sometimes copper-coloured, like oxalate of platinum, but still more beautiful than the crystals of the latter. In the light and at a temperature of boiling water this compound undergoes no change, but when heated to above this point it is decomposed into hydrocyanic acid and cyanuret of platinum. If its solution in alcohol is mixed with some nitric acid we obtain a liquid which evaporates, and heated strongly on a glass plate, forms an exceedingly beautiful platinum mirror.

There may be formed also a similar compound with iridium (Hy Cy + Ir Cy), whose properties are perfectly analogous to the above compound with platinum.*

ON VOLTAIC COMBINATIONS.

In February, a paper was read before the Royal Society, by John Frederick Daniel, Esq., F.R.S., Professor of Chemistry in King's College, London, entitled, "On Voltaic Combinations," in a letter to Michael Faraday, Esq., D.C.L., F.R.S., &c.

The author, after expressing his obligations to Mr. Faraday for the important light which his late researches in electricity have thrown on chemical science, proceeds to state that in pursuing the train of inquiry which has thus been opened, he has obtained further confirmations of the truth of that great principal discovered and established by Mr. Faraday, namely, the definite chemical action of electricity; and has thence been led to the construction of a voltaic arrangement which furnishes a constant current of electricity for any required length of time.

For the purpose of ascertaining the influence exerted by the different parts of the voltaic battery in their various forms of combination, he contrived an apparatus, which he designates by the name of the dissected battery, and which consists of ten cylindrical glass cells, capable of holding the fluid electrolytes, in which two plates of metal are immersed; each plate communicating below, by means of a separate wire, which is made to perforate a glass stopper closing the bottom of the cell, with a small quantity of mercury, contained in a separate cup underneath the stopper, and with which electric communications may be made at pleasure through other wires passing out of the vessel on each side. The active elements of the circuit, which were adopted as standards of comparison, were, for the metals, plates of platinum and amalgamated zinc three inches in length by one in breadth; and for the electrolyte, water ascidulated with sulphuric acid, in the proportion of 100 parts by volume of

* Poggendorff's Annals, 1836, No. 3; quoted in the Philosophical Magazine, No. 54.

the former to 2·25 of the latter; this degree of dilution (giving a specific gravity of 1·0275,) being adopted, in order to connect the author's experiments with those of Mr. Faraday.

This dilute acid exerts scarcely any local action on amalgamated zinc; because the surface of the metal becomes covered with bubbles of hydrogen gas, which adhere strongly to it; and this force of heterogeneous adhesion appears to have an important influence on the phenomena both of local and of current affinity, and soon puts a stop to the decomposition of the water by the zinc. When a small quantity of nitric acid is added to the acidulated water, the same plate which in the former experiment resisted the action of the diluted sulphuric acid, is, in a few hours, entirely dissolved, without the extrication of any gaseous matter. This result is explained by the author on the supposition that the elements of the nitric acid enter into combination with the hydrogen as it is evolved, and that the opposing attraction of this latter substance is thus removed. The author finds, in like manner, that nascent hydrogen deoxidates copper, and precipitates it from its solutions upon the negative plate of the voltaic circuit.

A series of experiments performed with the dissected battery is next described; illustrating, in a striking manner, the difference of effects with relation to the quantity and the intensity of the electric current, consequent on the different modes of connecting the elements of the battery; the former property being chiefly exhibited when the plates of the respective metals are united together so as to constitute a single pair; and the latter being exalted when the separate pairs are combined in alternate series. The influence of different modifications of these arrangements, and the effects of the interposition of pairs in the reverse order, operating as causes of retardation, are next inquired into.

In the course of these researches, the author, being struck with the great extent of negative metallic surface over which the deoxidating influence of the positive metal appeared to manifest itself, as is shown more especially in the cases where a large sheet of copper is protected from corrosion by a piece of zinc or iron of comparatively very small dimensions, was induced to institute a more careful examination of the circumstances attending this class of phenomena; and was thus led to discover the cause of the variations and progressive decline of the power of the ordinary voltaic battery, one of the principal of which is the deposit of the zinc on the platina [or copper] plates; and to establish certain principles from which a method of counteracting this evil may be derived. The particular construction which he has devised for the attainment of this object, and which he denominates the constant battery, consists of a hollow copper cylinder, containing within it a membraneous tube formed by the gullet of an ox, in the axis of which is placed a cylindrical rod of zinc. The dilute acid is poured into the membraneous tube from above by means of a funnel, and passes off, as occasion requires, by a siphon tube at the lower part; while the space between the tube and the sides of the copper cylinder is filled with a solution of sulphate of copper, which is preserved in a state of saturation by a quantity of this substance suspended in it by a colander, allowing it to percolate in proportion as it is dissolved. Two principal objects are accomplished by this arrangement; first, the removal out of the circuit of the oxide of zinc, the deposit of which is so injurious to the continuance of the effect of the common battery; and, secondly, the absorption of the hydrogen evolved upon the surface of the copper, without the precipitation of any substance which would lead to counter-

act the voltaic action of that surface. The first is completely effected by the suspension of the zinc rod in the interior membraneous cell into which fresh acidulated water is allowed slowly to drop, in proportion as the heavier solution of the oxide of zinc is withdrawn from the bottom of the cell by the siphon tube. The second object is attained by charging the exterior space surrounding the membrane with a saturated solution of sulphate of copper, instead of diluted acid; for, on completing the circuit, the electric current passes freely through this solution, and no hydrogen makes its appearance upon the conducting plate; but a beautiful pink coating of pure copper is precipitated upon it, and thus perpetually renews its surface.

When the whole battery is properly arranged and charged in this manner, it produces a perfectly equal and steady current of electricity for many hours together. It possesses also the further advantages of enabling us to get rid of all local action by the facility it affords of applying amalgamated zinc; of allowing the replacement of the zinc rods at a very trifling expense; of securing the total absence of any wear of the copper; of requiring no employment of nitric acid, but substituting in its stead materials of greater cheapness, namely, sulphate of copper, and oil of vitriol; the total absence of any annoying fumes; and lastly, the facility and perfection with which all metallic communications may be made and their arrangements varied.*

ON A NEW METHOD OF PREPARING IODOUS ACID.

By Lewis Thompson, Esq., Member of the Royal College of Surgeons.†

I SEND you a new method of preparing iodic acid; it is cheaper and safer than the process of Sir Humphry Davy, and affords a purer acid than the plan pursued by Gay-Lussac. I say purer, because from some experiments which I have lately made, and intend to repeat more carefully, I am led to conclude with Sir Humphry Davy, that the acid of Gay-Lussac is sulpho-iodic acid.

Process for preparing Iodic Acid.

Put one atom or 126 grains of iodine into a proper bottle with 24 ounces of water, and pass chlorine, previously washed in cold water, through the mixture until it shall have become colourless; set the solution aside for an hour; then heat it to 212° Fahr., to disengage the uncombined chlorine, and add 2½ atoms or 295 grains of recently precipitated oxide of silver; boil the whole for ten minutes, filter, and evaporate carefully to dryness; the product is pure anhydrous iodic acid.

It will be at once perceived by the above process that there is no such acid as the chloriodic, the acid so called being in fact merely a chloride of iodine, which when dissolved in water is converted into muriatic and iodic acids, with a variable quantity of iodine. How this mistake can have passed so long unnoticed is to me a matter of surprise; at the same time I must observe

* Philosophical Magazine, No. 48.

† To the Editors of the Philosophical Magazine.

that I have not been able to unite chlorine and iodine in the proportions necessary to form these acids without the intervention of water; there is always an excess of iodine: but I have no doubt that this may be effected in a sufficiently reduced temperature. In the last experiment which I made on this subject 50 grains of iodine combined with 41·5 cubic inches or about 30 grains of chlorine; the substance thus formed when put into a large quantity of water, and exposed for some days to the sunshine, deposited 8 grains of iodine and became of a pale yellow colour.

That the muriatic and iodic acids exist ready formed in the solution I am confident, not only from the taste and smell, but because I have obtained free muriatic acid from it by distillation, although when this is continued until the solution becomes a good deal concentrated, those acids react upon each other and produce chlorine and iodine.

As the iodate of ammonia is not noticed in any work with which I am acquainted, I think it right to observe here that it is a highly crystalline granular powder, possessed of but little solubility: it may be prepared by saturating the solution of the muriatic and iodic acids with pure ammonia, when it will fall down, the muriate remaining dissolved. I find that iodic acid is decomposed by sulphocyanic acid and the sulphocyanates of potash and soda; and also that saliva, in consequence probably of the sulpho-cyanate of potash it contains, decomposes iodic acid, and produces with it and starch a blue precipitate not to be distinguished from that produced under similar circumstances by morphia. The importance of this discovery in a medico-legal point of view is considerable, since iodic acid is now very much relied upon as a test for morphia.*

ON THE CHANGE IN THE CHEMICAL CHARACTER OF MINERALS INDUCED BY GALVANISM.

By R. W. Fox.

At the late meeting of the British Association, Mr. Fox mentioned the fact, long known to miners, of metalliferous veins intersecting different rocks containing ore in some of these rocks, and being nearly barren or entirely so in others. This circumstance suggested the idea of some definite cause; and his experiments on the electrical magnetic condition of metalliferous veins, and also on the electric conditions of various ores to each other, seem to have supplied an answer, in as much as it was thus proved that electro-magnetism was in a state of great activity under the earth's surface; and that it was independent of mere local action between the plates of copper and the ore with which they were in contact, was shown by the occasional substitution of plates of zinc for those of copper producing no change in the direction of

* Philosophical Magazine, No. 56.

the voltaic currents. He also referred to other experiments, in which two different varieties of copper ore, with water taken from the same mine, as the only exciting fluid, produced considerable voltaic action. The various kinds of saline matter which he had detected in water taken from different mines, and from different parts of the same mine, seemed to indicate another probable source of electricity; for, can it now be doubted, that rocks impregnated with or holding in their minute fissures different kinds of mineral waters, must be in different electrical conditions or relations to each other? A general conclusion is, that in these fissures metalliferous deposits will be determined according to their relative electrical conditions; and that the direction of those deposits must have been influenced by the direction of the magnetic meridian. Thus we find the metallic deposits in most parts of the world having a general tendency to an E. and W. or a N.E. and S.W. bearing. Mr. Fox added, that it was a curious fact, that on submitting the muriate of tin in solution to voltaic action, to the negative pole of the battery, and another to the positive, a portion of the tin was determined like the copper, the former in a metallic state, and the latter in that of an oxide, showing a remarkable analogy to the relative position of tin and copper ore with respect to each other as they are found in the mineral veins.

The Chairman, (Dr. Buckland,) said, it had been observed to them last evening, that the tests of some of the highest truths which philosophy had brought to light was their simplicity. He held in his hand a blacking-pot, which Mr. Fox had bought yesterday for a penny, a little water, clay, zinc, and coper; by which humble means he had imitated one of the most secret and wonderful processes of nature, her mode of making metallic veins.*

RECENT EXPERIMENTS TO PROTECT TIN PLATE OR TINNED IRON FROM CORROSION IN SEA-WATER, AND ON THE POWER OF ZINC TO PROTECT OTHER METALS FROM CORROSION IN THE ATMOSPHERE.

By Edmund Davy, F.R.S., M.R.I.A., &c.

If a piece of tin plate is exposed in sea-water for a few days, it will exhibit an incipient oxidation, which will gradually increase; the tin will be preserved at the expense of the iron, which will be corroded. But if a small surface of zinc is attached to a piece of tin plate and immersed in sea-water, both the tin and iron will be preserved, whilst the zinc will be oxidated, on the principle first made known by the late Sir H. Davy.

The author has exposed for nearly eight months in sea-water a surface of tin plate nailed to a piece of wood by means of tinned

* Philosophical Magazine, No. 53.

iron tacks, inserting between the wood and the tin plate a small button of zinc. Under these circumstances the tinned plate has remained clean and free from corrosion; the zinc has of course been corroded. In a comparative experiment, in which a similar piece of tin plate was nailed to the same piece of wood, and exposed during the same period to the same quantity of sea-water, without the zinc, the edges on two sides of the tin plate were quite soft from the corrosion, which had extended to about one-eighth of an inch. These experiments seem worthy of being repeated and extended.

The present demand for tin plate is very great; should these statements be confirmed, a vast increase in its consumption might be anticipated. The opinion may be entertained that it is practicable to substitute double tin plate for sheet copper in covering the bottoms of ships, &c., using zinc in small proportions as a protector. Such applications would probably occasion a saving of nearly three-fourths of the present expense of copper sheathing.

It also seems deserving of inquiry, whether tin plate vessels, protected by zinc, may not be advantageously substituted for copper vessels in many of our arts and manufactures, and even in domestic economy. Although it might be presumed, from Sir H. Davy's experiments and observations, that zinc would protect tin plate from corrosion in sea-water, the author is not aware that any direct experiments on the subject have been published. Sir H. Davy briefly refers to some obvious practical applications of his researches, to the preservation of finely divided astronomical instruments of steel by iron or zinc; and that Mr. Pepys had taken advantage of this last circumstance, in inclosing fine cutting instruments in handles or cases lined with zinc. The author has not heard whether such applications have succeeded, but he has made a number of experiments with a view to protect brass, iron, copper, &c., from tarnish and corrosion in the atmosphere by means of zinc; the results obtained, however, lead to the conclusion, that contact with zinc will not protect those metals in the atmosphere, the electricity thus produced, without the intervention of a fluid, being apparently too feeble to counteract the chemical action of air and moisture on the surfaces of the metals.*†

AMALGAMATION OF ZINC PLATES.

In consequence of the great advantages pointed out by Mr. Faraday, of employing amalgamated zinc plates in the voltaic pile, M. Masson recommends the following simple and rapid method. After having placed on the zinc a little mercury, dilute

* The negative results thus obtained by Mr. E. Davy, agree exactly with those of some recent trials for protecting steel by this means.

† Repertory, No. 25

sulphuric acid is poured upon it; the mercury is then rubbed over the surface of the zinc by means of a piece of linen. The mercury spreads over the surface with great facility, and the amalgamation is very rapid: a small quantity of dilute acid should be added from time to time; this appears to act as a cleanser to the zinc, for in forming a voltaic circuit with only one element, the operation does not go on so well or so quickly.*

THEBAIA, A NEW ALKALI IN OPIUM.

M. Couerbe discovered this new substance in the solution from which the muriates of morphia and codeia had been separated by Gregory's process. It was separated by its discoverer in the following manner: the mother waters above mentioned were evaporated to the consistence of a syrup; this contains bimeconate of lime, morphia, narceia, meconin, narcotina, and thebaia: muriatic acid is to be added, to separate a black, fatty matter, containing ulmic acid, which is removed by a skimmer from the surface of the liquid. To the solution thus purified, ammonia is to be added, which occasions a black deposit of morphia and thebaia. This precipitate is to be dried, powdered, and treated with boiling æther, in which the thebaia, though only slightly soluble, dissolves. When the æther is separated by distillation, the thebaia is deposited in small reddish crystals, which are to be purified by boiling in alcohol, with animal charcoal. It is then to be dissolved in æther, and by spontaneous evaporation crystals are obtained.

Thebaia, thus prepared, is perfectly white, strongly alkaline, and soluble in alcohol and æther. In the first liquid it crystallizes, like the sugar of grapes, in small mammillated crystals; but in the second, in brilliant flat rhombic crystals. When heated to about 266° it fuses, and does not solidify till its temperature is reduced to 130°; whereas narcotina fuses at 338°, and solidifies at 266°.. Codeia fuses at 302°, and meconin at 194°. By fusion, thebaia loses 4 per cent., or two equivalents of water. Concentrated acids convert it into a resinous substance, whereas, when properly diluted, they combine and form crystallizable salts with it. By friction it becomes negatively electrical.

It is composed, according to M. Couerbe, of

Carbon	71·976	= 25	equivalents	nearly.
Azote	6·385	= 2	do.	
Hydrogen	6·460	= 27	do.	
Oxygen	15·279	= 4	do.	

M. Couerbe gives the following table of the colours produced by agitating the peculiar substances of opium in a bottle, with sulphuric acid and air. Nitric acid oxidizes them so rapidly,

* Annales de Chimie, November 1835; quoted in the Philosophical Magazine, No. 50.

that the progress of the oxidation cannot be followed. The experiment is to be made in a four-ounce phial, with six grains of the substance, with nearly half an ounce of sulphuric acid, containing nitric acid: strong agitation is to be employed. At first the colour is not very deep; but it is developed in a few minutes.

Thebaia is rendered instantly red, becoming deeper and deeper by time; when examined in thin portions, the colour has a yellowish tint.

Narcotina, at first yellow, and remains so for seven or eight minutes, then becomes red.

Codeia immediately becomes of a very pale green colour, which passes to a *vert-russe* after some time

Morphia becomes almost immediately of a green colour.

Meconin, no immediate effect, but in 24 hours the mixture becomes of a superb rose colour.

Narceia immediately becomes nearly of a mahogany colour.

When sulphuric acid, which contains no nitric acid, is employed, then—

Thebaia gives a rose colour, with a shade of yellow;
Narcotina, a blood-red colour;
Codeia, a green colour;
Morphia, a brown colour;
Meconin, first a turmeric yellow, and then red;
Narceia, a chocolate colour.

M. Couerbe obtained from 40 pounds (French) of opium, the following products:

1 ounce of meconin,
1½ ounce of codeia,
¾ ounce of narceia,
1 ounce of thebaia,
50 ounces of morphia.

The narcotina, which remained in the *marc*, was not extracted.*

MAGNETIC EXPERIMENTS IN AN IRON STEAM VESSEL.

On March 10, was read, before the Royal Society, the "Report of Magnetic Experiments tried on board an Iron Steam Vessel, by order of the Right Hon. the Lords Commissioners of the Admiralty," by Edward J. Johnson, Esq., Commander, R.N., accompanied by plans of the vessel, and tables showing the horizontal deflection of the magnetic needle at different positions on board, together with the dip and magnetic intensity observed at those positions, and compared with that obtained on shore with the same instruments; communicated by Captain Beaufort, R.N., F.R.S., Hydrographer to the Admiralty, by command of the Right Hon. the Lords Commissioners of the Admiralty.

* Annales de Chimie et de Physique, lix., 136; quoted in the Philosophical Magazine, No. 48.

This report commences with a description of the iron steam vessel, the Garryowen, belonging to the City of Dublin Steam Packet Company, and built by the Messrs. Laird, of Liverpool. She is constructed of malleable iron, is 281 tons burthen, and draws only 5½ feet water, although the weight of iron in the hull, machinery, &c., is 180 tons.

This vessel was placed, under the directions of the author, in Tarbert Bay, on the Shannon, on the 19th of October, 1835, for the purpose of investigating its local attractions on the compass. The methods which were adopted with that view are given; together with tables of the results of the several experiments, and plans of the various parts of the Garryowen. The horizontal deflections of the magnetic needle at different situations in the vessel were observed, for the purpose of ascertaining the most advantageous place for a steering compass, and also for the application of Professor Barlow's correcting-plate; and the dip and intensity in these situations were, at the same time, noted.

An experiment is detailed, showing that where several magnetic needles, freely suspended, were placed upon the quay, in Tarbert Bay, and the vessel warped from the anchorage towards them, first with her head in that direction, and then with her stern, opposite deflections were produced: in the first case, all the needles showing a deviation to the eastward, and in the latter to the westward, of the true magnetic meridian.

Considering the height of the general mass of iron in the vessel, and also that of the head and stern, together with the distance, (169 feet,) at which some of the needles indicated a deviation, the author concludes that the respective deflections were caused by the magnetic influence of the iron in the vessel; the combined effect of that about the bows representing the north pole of a magnet, and that about the stern a south pole. He then offers several suggestions for future observation on this subject, and connected with the little oxidation that is reported to have taken place in the vessel.

The experiments having been interrupted by a continuance of wet and stormy weather, the author proceeds to draw the following general practical conclusions, deduced from the series of observations already made, and points out the further experiments which he considers necessary to be tried.

'1st. The ordinary place for a steering-compass on board ship is not a proper position for it in an iron steam vessel.

2nd. The binnacle-compass, in its usual place, on board the Garryowen, is too much in error to be depended upon.

3rd. In selecting a proper position for a steering-compass on board iron steam vessels, attention should be paid to its being placed, as far as is practicable, not only above the general mass of iron, but also above any smaller portions of iron that may be in its vicinity; or such portions of iron should be removed altogether.

4th. The steering-compass should never be placed on a level with the ends either of horizontal or of perpendicular bars of iron.

5th. The extreme ends of an iron vessel are unfavourable positions, in consequence of magnetic influences exerted in those situations. The centre of the vessel is also very objectionable, owing to the connecting rods, shafts, and other parts of the machinery belonging to the steam-engine and wheels, which are in continual motion; independently of the influence exerted by the great iron tunnel in this part of the ship.

6th. No favourable results were obtained by placing the compass either below the deck, or on a stage over the stern.

7th. It was found that, at a position 20½ feet above the quarter-deck, and at another 13¾ feet above the same level, and about one-seventh the length of the vessel from the stern, the deflections of the horizontal needle were less than those which have been observed in some of his Majesty's ships.

The author proceeds to point out various methods of determining, by means of a more extended inquiry, whether the position above indicated, or one nearer to the deck, is that at which the steering-compass would be most advantageously placed.

The concluding section contains an account of some observations made by the author on the effects of local attraction on board different steam boats, from which it appears, that the influence of this cause of deviation is more considerable than has been generally imagined; and he points out several precautions which should be observed in placing compasses on board such vessels.*

ACTION OF ACIDS UPON SUGAR.

MALAGUTI finds,—1st, that both organic and inorganic acids act in the same way upon sugar, when influenced by heat; and that it is transformed first into sugar of grapes, then into ulmic acid, and (if atmospheric air be present) into formic acid. 2nd. When cane sugar is changed into sugar of grapes, the action of the acids takes place even at common temperatures. 3rd. That the smallest quantity of acid acts in the same manner, but more slowly. An acid less dilute will act more quickly than an acid more dilute. 4th. Dilute acids, under the action of atmospheric air, cannot transform sugar into formic acid. 5th. The action of alkalies upon sugar is identical with that of acids.—His experiments confirm the accuracy of the composition assigned to ulmic acid by Boullay, viz. $C_2\ H\ O$. Ulmic acid may be readily formed by boiling together 10 parts sugar, 30 water, and 1 concentrated sulphuric acid. In three quarters of an hour a scum forms on the surface, which may be skimmed off; in a few minutes it is formed anew. This scum is ulmic acid, with a little ulmin, which may be separated by ammonia. Water should be added occasionally, in order to replace what evaporates.†

* Philosophical Magazine, No. 50.

† Annales de Chimie; quoted in Thomson's Records, No. 14.

VOLATILE LIQUID PROCURED FROM CAOUTCHOUC.

By William Gregory, M.D., F.R.S.E.

Some years ago, a patent was taken out by Mr. Enderby, of London, for the production of a volatile inflammable liquid by the distillation of caoutchouc. This liquid possesses very remarkable properties. As prepared by Mr. Enderby, it is colourless, very fluid, has no taste, but a peculiar æthereal smell. Its specific gravity is very low, being = 0·680, and it boils at a temperature below 100° Fahrenheit. As no examination of this remarkable substance has yet been published, I venture to offer the results of some experiments which I have made on it at intervals during the last two years.

As Mr. Enderby purifies his oil by rectification alone, my first object was to push that process as far as possible, so as to get rid of the less volatile matters which might be present. By successive rectifications, carried on without ebullition, at about 80° to 90° Fahr., I at last obtained a liquid having the specific gravity of 0·666 at 60° Fahr., approaching very nearly to that of the eupion of Dr. Reichenbach, obtained by the distillation of oil, viz 0·655. The new liquid, however, is not eupion, for it boils at about 90° Fahr., and is instantly decomposed by oil of vitriol; while eupion boils at 110° Fahr., and resists the action of that acid.

The boiling-point of the new oil is not constant. That of sp. gr. 0·670 begins to boil at 95° Fahr., but the temperature soon rises, and towards the end of the distillation reaches 170° Fahr. Consequently, we cannot consider it as an unmixed compound.

Having taken some of this liquid with me to Giessen, last year, I submitted it to analysis under the eye of Professor Liebig. Although I did not expect any very satisfactory result from the analysis of a substance confessedly not free from mixture, I was rather surprised to obtain results indicating a composition, in 100 parts, identical with that of olefiant gas.

I next proceeded to examine the action of sulphuric acid on the new liquid. When the acid is added to it in large quantity, part of the oil is decomposed instantaneously, while the rest is dissipated by the heat evolved, leaving a black semifluid mass. But if the acid be added gradually to the oil at the bottom of a long tube, which is closed by the thumb and cooled down after each addition, a colourless liquid is obtained, swimming on the surface of the black mass above mentioned. When the addition of new acid causes no further developement of heat, the liquid may be decanted, washed with solution of potash, and rectified over chloride of calcium.

This liquid has properties very distinct from those of the oil which has yielded it. It has acquired an aromatic smell, resembling that of turpentine, and it now boils at about 440° Fahr. Notwithstanding, however, this remarkable change, the analysis

of the modified oil gave results closely coinciding with those of the original liquid, viz., a composition identical, in 100 parts, with that of olefiant gas.

These analyses were made in September 1835. In the Annalen der Pharmacie, October 1835, Professor Liebig has directed the attention of chemists to the remarkable alteration produced by sulphuric acid on the oil of caoutchouc; and has conjectured that the change consisted in the conversion of that oil into eupion, which resists sulphuric acid. If so, he proceeds, then it is possible that eupion may be only produced from the oil of tar by the action of the sulphuric acid employed in its preparation.

I cannot acquiesce in this view. The eupion of Reichenbach boils at 110° Fahr., and the oil alluded to at 440° Fahr.; moreover, their odour is quite different: and if we are to admit them to be essentially the same, one of them must be in the highest degree impure, implying the presence of some other substance.

I must, however, mention here a singular fact. Having myself subjected caoutchouc to destructive distillation, I obtained none of Mr. Enderby's oil; but, on adding sulphuric acid to the more volatile products, I got what I conceived to be impure eupion. My failure in procuring the new oil I ascribe to a difference in the temperature employed.

Professor Liebig is inclined to the opinion that the other substances described by Reichenbach are products of reaction, and not educts. But I venture to remind him that creosote, for example, may be detected in tar, by its smell and by its antiseptic virtue; that, according to Reichenbach, both eupion and paraffine may be sufficiently purified, by rectification alone, to exhibit their characteristic properties; and that paraffine may be extracted from the petroleum of Rangoon, in a state of absolute purity, without the employment of any more active solvent than sulphuric æther.

M. Hess, in a note read in the Imperial Academy of Sciences of St. Petersburg, on the 11th of March, 1836,* mentions some circumstances which are highly interesting in reference to the present subject. After referring to the analogy of the oil of petroleum with the eupion of Reichenbach, (an analogy which I had demonstrated in a paper read to the Royal Society of Edinburgh in December 1834, and since published in their Transactions,) he states that in following Reichenbach's process for the preparation of eupion from oil, he obtained a liquid of sp. gr. 0·71, which, by the action of potash, he obtained at last so light as 0·648, and boiling from 68° to 110° Fahr.

This liquid he found to have the composition of olefiant gas; it contained, he says, but very little eupion, which might be separated by sulphuric acid.

* Annales de Chimie, vol. lxi., p. 331.

Now my experiments above described render it extremely probable that M Hess' liquid is identical with that of Mr. Enderby's; and that the oil separated from it by sulphuric acid is not eupion, but the second oil analyzed by me.

As M. Hess had previously shown that the pure oil of petroleum had the same composition as olefiant gas, and was in its properties, as I had also proved, very analogous to eupion, he thinks it highly probable that the composition of eupion is the same.

He then proceeds to divide the very numerous compounds, which agree in containing, like olefiant gas, about 85·7 per cent. of carbon. and 14·3 per cent. of hydrogen, into two series. The one, of which paraffine, eupion, and olefiant gas are examples, he calls passive, because they do not act on sulphuric acid; the other, of which Faraday's quadro-carburetted hydrogen, and the oil obtained by himself as well as Mr. Enderby's oil (if the two latter be not identical), are specimens he calls active, as they act strongly on the same acid. I have mentioned his views here, in order to direct attention to the striking fact, established by my experiments, that Mr. Enderby's oil, belonging to one of these classes, is, partially at least, converted by the action of sulphuric acid into a liquid belonging to the other series, and retaining the same composition.

Another circumstance well worthy of notice is the fact that several of the liquids in question yield uniform results as to composition, even when the portions analyzed differ in density and volatility. This has been shown to occur likewise in the oils of turpentine and lemons, and seems to indicate the existence of an almost unlimited number of polymeric combinations of carbon and hydrogen.

When Mr. Enderby's liquid was first made known, it was stated to be an excellent solvent for caoutchouc, which, from its great volatility, would have rendered it extremely valuable. But it is necessary to state, that I have not yet seen one specimen of it which, under any circumstances, in my hands, possessed this property. Two gentlemen informed me that they had succeeded in dissolving caoutchouc by means of it; but when asked to repeat the experiment with the same liquid, they both failed.* If, therefore, this liquid be a solvent for caoutchouc, it must be under conditions with which I am not acquainted.†

ELECTRICITY.

On March 17, a paper was read, before the Royal Society, "On the reciprocal attractions of positive and negative electric cur-

* We have been informed by Mr. Enderby, that the failures to which Dr. Gregory refers, are attributable to the spurious quality of the caoutchouc.—*Ed. Arcana.*

† Philosophical Magazine, No. 55.

rents, whereby the motion of each is alternately accelerated and retarded," by P. Cunningham, Esq., Surgeon R.N.; communicated by Alexander Copland Hutchison, Esq., F.R.S.

The author found that a square plate of copper, six inches in diameter, placed vertically in the plane of the magnetic meridian, and connected with a voltaic battery by means of wires soldered to the middle of two opposite sides of the plate, exhibited magnetic polarities on its two surfaces, indicative of the passage of transverse and spiral electrical currents, at right angles to the straight line joining the ends of the wires. The polarities were of opposite kinds on each side of this middle line, in each surface; and were reversed on the other surface of the plate. The intensities of these polarities, at every point of the surface, were greatest the greater its distance from the middle line, where the plate exhibited no magnetic action. The author infers from this and other experiments of a similar kind, that each electric current is subject, during its transverse motion, to alterations of acceleration and retardation, the positive current on the one side of the plate and the negative on the other, by their reciprocal attractions, progressively accelerating each other's motions, as they approach, in opposite directions, the edge round which they have to turn. After turning round the edge, their motion will, he conceives, be checked by coming in contact with the accelerating portions of the opposing currents to which they respectively owed their former increase of velocity; so that the one current will be retarded at the part of the plate where the other is accelerated. To these alternate accelerations and retardations of electric currents, during their progressive motion, the author is disposed to refer the alternate dark and luminous divisions in a platina wire heated by electricity, as was observed by Dr. Barker.*

SILICA IN PLANTS.

STRUVE has obtained the following results from an examination of the ashes of several plants.

		Silica.	Alumina.	Lime.	Manganese.
Equisetum	hyemale	97·52	1·7	0·69	
	limosum	94·85	0·99	1·57	1·69
	arvense	95·48	2·556	1·64	
Spongia	lacustris	94·66	1·77	2·99	
Calamus	Rotang	99·20		0·54†	

* Philosophical Magazine, No. 50.

† Erdmann und Schweigger Seidel's Journal; quoted in Thomson's Records, No. 14.

NATURAL HISTORY.

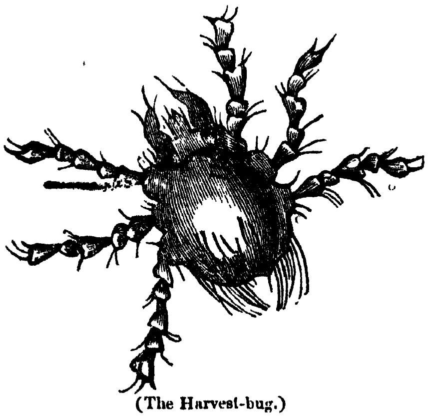
ZOOLOGY.

NOTICE OF THE HARVEST-BUG.*

Acarus autumnalis, Shaw.
Acarus Ricinus, Latreille.

If powers of annoyance form a claim to attention, there is none superior to that possessed by the minute insect known in England as the Harvest-bug, and on the Continent, where, according to Latrielle's personal experience, its effects are equally serious, as *la Louvette*.

No good description of it is, however, extant, and the engraving in Shaw's work bears a very slight resemblance to nature, owing, doubtless, to the extreme difficulty of obtaining specimens of an insect so nearly invisible to the naked eye. Having been so fortunate as to procure several uninjured harvest-bugs, and having submitted them to a highly powerful magnifier, so as to make a drawing, which underwent many comparisons with the living subject, and is as correct as it is possible to render it, an engraving from it is annexed, for the examination of the curious, together with such particulars as differ from the account of established authorities;—not from any wish to cavil or find fault with those who have done so much for entomology,



(The Harvest-bug.)

* Communicated to the Philosophical Magazine, No. 51; by Thomas John Hussey, D.D., Rector of Hayes, Kent.

but with an anxiety, laudable it is hoped, to add (without punning) a *mite* to truth.

The acarus in question then is a hexapod, of a brilliant scarlet colour: its motion is very swift, and the only way in which the observer can satisfactorily contemplate it is by immersing the insect in a drop of water, in which it swims vigorously,* and from which it cannot escape.

The body is oval, sprinkled with stiff hairs, and sixteen very strong ones fringe the hinder part; the legs are horny, like those of a beetle: each foot is furnished with two, and sometimes three, strong claws, with which it works so rapidly, mole fashion, that it inserts itself beneath the skin in a few seconds. Shaw states that it "adheres to the skin by means of two strong hooks attached to the fore-part of the body," but these I have never been able to see; he appears not to have been aware of its burying itself beneath the surface, in which case it is no longer possible to extract it; a small tumour then forms, the itching of which is intolerable. Patience, the panacea universally recommended, is as universally neglected. Serious consequences often arise in an irritable constitution, from broken sleep, and the skin being torn in frantic endeavours to procure relief. External applications are of little avail, the creature being safe beneath the skin; sal volatile, seldom had recourse to till the nails have failed, will change the itching to a pungent smart. As, however, is the case with all similar scourges, there are individuals perfectly exempt from its attacks.

Shaw, Latrielle, and White of Selborne, all state that this insect is located upon corn, kidney-beans, and various other vegetables; this they probably adopted from each other, the original foundation being popular belief: but having been assured, in the course of my researches on this subject, that† daddy long-legs (*phalangium opilio*) was the father of harvest bugs, and the common red garden spider their prolific mother, and having heard a regular war determined against them as the origin of all the suffering, I may be excused for doubting the value of popular opinions; and let us hope that these absurd fancies of persons who ought to have known better will vanish before the light shed by the popular study of entomology.

The evidence then appears strongly to favour the opinion that the habitat of the harvest-bug is upon, or close to, the ground. White says that, "upon the chalk-downs, the warrener's nets are sometimes coloured red by them;"‡ and, incredible as this may appear to one engaged in contemplating a single specimen,

* One specimen was still swimming after a lapse of seven hours.

† Probably from his being frequently covered with another parasitic acarus, *acarus ocypete*.

‡ Chalk is the favourite soil; and, perhaps, their abounding in corn-fields, is owing to the earth being so dry among the ripe straw, and so warm also.

there is no doubt of the truth of the statement, even though it had rested on meaner authority, for the hem of many a Hampshire petticoat has been similarly discoloured, the wearer of which, by throwing it off in time, prevented the ravages of the insect being extended to the upper part of the person. Experienced sportsmen well know that, on the moors, they escape the enemy by wearing a close boot. After walking some time upon gravel, far removed from any plant whatever, the stockings will be found sprinkled with them, when, running rapidly upwards, they ensconce themselves wherever the dress is most closely confined to the body. Animals, particularly horses, suffer dreadfully from this cause, the tender skin of the lips and nose being frequently covered with nests of harvest-bugs, which have fixed there during grazing, but which probably cannot bury themselves as in the human being, from the toughness of the skin. The cat's whiskers have a scarlet spot at the insertion of each hair, and she bites her paws all day, yet does not relinquish her favourite bask on the warm gravel, which probably is the cause of her annoyance, because the rabbits, shut up in a building, though fed even on the freshest of kidney-bean plants, are not aware that harvest-bugs exist.

If it be asked where was the embryo harvest-bug,—where was the insect whose life, beginning, as it would seem, with the greatest heat of summer, ended with the first cold of autumn,—during the intermediate nine months? we may reply, probably buried in embryo in the soil. But research would afford no information on this subject, from the minuteness of the insect.

ON THE SPECIFIC CHARACTERS OF THE LARGER CETACEA, AS DEDUCED FROM THE CONFORMATION OF THE BONES OF THE EAR.

By M. Vanbeneden.

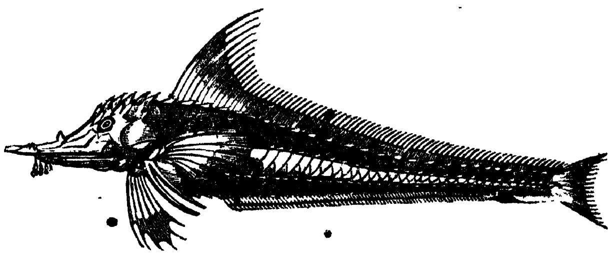
It is often very difficult, M. Vanbeneden remarks, to distinguish between the different species of whales, if you have not an opportunity of examining the specimens in a fresh state, or of comparing their crania. But, in the arrangement of the bones of the ear, an equally important character is found, although it has not hitherto been noticed, notwithstanding that its application might be often most useful. A voyager would have much less difficulty to give an account of the bones of the ear of a whale, than of its whole cranium, and might in this way as effectually obtain all the necessary information for determining the species. In this way we may speedily have, in all the museums, a series of preparations of comparative anatomy, which, for this order of the mammalia, will be the representation of the various genera and species; as, in the other orders, there is a series which exhibits the formulary of the dental apparatus. The genus Rorqual, which is clearly distinguished by external marks, is not

less so by those afforded by the examination of the ear, and this is also true of the several species of the genus. From this source, then, we may obtain valuable data for ascertaining the geographic distribution of these animals. Thus, it is not now known how far the rorqual, which is distinguished as the Mediterranean species, penetrates towards the North Pole; but the bones of the ear, which were last year described by MM. Quoy and Gaimard, during their voyage to Iceland, demonstrate that this species penetrates much farther in that direction than was previously supposed. This character is also important in the determination of fossil species. Thus a bone of the ear, found by M. Vanbeneden in the province of Anvers, has been recognised to belong to a rorqual, but of a species different from those which are known as existing at the present time.*

DESCRIPTION OF A NEW BRITISH FISH.

By Edward Moore, M.D., F.L.S., Secretary to the Plymouth Institution.

This fish was caught on the usual fishing-ground between Plymouth and the Eddystone, by the crew of a trawl sloop belonging to Mr. Bulley of this town, and brought fresh to me by Mr. W. Snow Harris, F.R.S.; in which state it was also seen by Lieut. Col. C. Hamilton Smith. It has since been inspected by Mr. Couch of Polperro and Mr. Yarrel, both of whom pronounce



(New British Fish.)

it new to Britain. The characters are as follow:—It is the Peristédion Malàrmat of Lacepéde and Cuvier, Trìgla cataphràcta Lin., Mailed Gurnard. Its length is 11 in.; from the nose projects a forked snout 1 in. long, the divisions being half an inch apart at the base, where there are three small mammillary projections. From the snout to the base of the pectoral fin, it measures 3½ in.; the head is armed with numerous tooth-like processes, of which three are placed triangularly on the nose, six over the eye, three larger on the forehead, and thence they

* Jameson's Journal, No. 43.

extend in a serrated manner, down the back to the tail. The orbit of the eye is oval; iris silvery; a projecting bony ridge extends across the cheek-plate, from the nose to the base of the pectoral fin; the jaws are cartilaginous and toothless; the chin is furnished with several cirri; at the under side of each division of the snout are three openings, covered with a delicate membrane, through which a pin can be easily passed down to the nose.

The body is octagonal, covered with bony scales, laid over each other like a coat of mail; from the centre of each scale, forming the edge of the octagon, there projects a sharp hook-like process, together forming eight serrated ridges from head to tail; The number of these hooks is as follows:—Dorsal ridge, twenty-nine scales; superior lateral, thirty; inferior lateral and abdominal, each twenty-three: the small number of the latter is owing to the three pectoral scales, where the fins play, being much enlarged; they are, also, free from points, and united with the abdominal plates, three of which, of different dimensions, extend on each side from the neck to the vent.

The formula for the fin rays will be as follows:—Dorsal, tweny-six; the first twelve or fourteen extending much beyond the others. Pectoral, eight, 2 in. long, with only two free rays below it. Ventral, six, 1½ in. long. Anal, sixteen. Caudal, fourteen, 1½ in. long, slightly forked. The chief flexible points appear to be at the neck and the junctions of the gill-plates: the motion of the other parts of the body is much impeded by the firmness of the imbrications with which the whole of the fish is surrounded. Its colour, when fresh, was of a uniform scarlet, like the red gurnard, gradually softening to pale flesh-colour towards the abdomen; the anal and dorsal fins were crimson; but the others pale and greyish. The Peristédion coloured in the Naturalist's Miscellany is from a dried specimen.

This is, probably, a young fish, as it is said to be found, sometimes, in the Mediterranean, 2 ft. long. (Dict. d'Hist. Nat., t. 25.) It has been long separated from the gurnards by the French naturalists, and should have a different English name, as it is totally distinct from that family.*

OBSERVATIONS UPON THE HABITS OF THE PLECOTUS AURITUS OR LONG-EARED BAT.

By J. de C. Sowerby, Esq., F.L.S.†

About the beginning of August last, a living specimen of the Long-eared Bat was given to my children. We constructed a cage for him by covering a box with gauze and making a round

* Magazine of Natural History, No. 1, New Series.

† Read at the first Philosophical Meeting of the Camden Literary and Scientific Institution, January 26th, 183[illegible].

hole in the side fitted with a phial cork. When he was awake we fed him with flies introduced through this hole, and thus kept him for several weeks. The animal soon became familiar, and immediately a fly was presented alive at the hole he would run or fly from any part of the cage and seize it in our fingers, but a dead or quiet fly he never would touch. At other times dozens of flies and grass-hoppers have been left in his cage, and waking him by their noise, he dexterously caught them as they hopped or flew about, but uniformly disregarded them while they were at rest. The common Blatta, hard Beetles, and Caterpillar he refused, even after he had been induced by their moving to attack them. As we became still more familiar our new friend was invited to join in our evening amusements, to which he contributed his full share by flitting round the room, at times settling upon our persons and permitting us to handle and caress him. He announced his being awake by a shrill chirp, which was much more acute than that of the Cricket. Now was the proper time for feeding him. I before stated that he only took his food alive: it was also observed that not only was motion necessary, but that generally some noise on the part of the fly was required to induce him to accept it; and this fact was soon discovered by the children, who were entertained by his taking flies from their fingers as he flew by them, before he was bold enough to settle upon their hands to devour his victims. They quickly improved upon their discovery, and by imitating the booming of a bee, induced the bat, deceived by the sound, to settle upon their faces, wrapping his wings round their lips and searching for the expected fly. We observed that if he took a fly while on the wing, he frequently settled to masticate it; and when he had been flying about a long time he would rest upon a curtain, pricking his ears and turning his head in all directions, when if a fly were made to buzz, or the sound imitated, he would proceed directly to the spot, even on the opposite side of the room, guided, it should appear, entirely by the ear. Sometimes he took his victim in his mouth, even though it was not flying; at other times he inclosed it in his wings, with which he formed a kind of bag-net; this was his general plan when in his cage, or when the fly was held in our fingers or between our lips.

From these observations I should conclude that many of the movements of the Bat upon the wing are directed by his exquisite sense of hearing. May not the sensibility of this organ be naturally greater in those animals whose organs of vision are too susceptible to bear daylight, when those organs, from their nature, would necessarily be of most service? such as the cat, who hunts much by the ear, and the mole, who feeding in the dark recesses of his subterranean abode is very sensible of the approach of danger and expert in avoiding it. In the latter case large external ears are not required, because sound is well conveyed by solids and along narrow cavities. In the cases of many bats and

of owls the external ears are remarkably developed. Cats combine a quickness of sight with acute hearing; they hunt by the ear, but they follow their prey by the eye. Some bats are said to feed upon fruits; have they the same delicacy of hearing, feeling, &c. as others?*

ZOOLOGY OF BOOTHIA.

CAPT. J. CLARK ROSS, the nephew and companion of the dauntless adventurer, Sir John Ross, under whose command the recent Arctic expedition was undertaken, being a competent naturalist, has drawn up that portion of the volume which relates to Zoology; and of this account we have attempted to give a mere outline. In the list, it will be observed, there are nineteen species of mammalia, and of these twelve are terrestrial and seven aquatic. There are forty-one birds, of which nineteen are terrestrial and twenty-two aquatic. The number of fishes is fifteen. There is no mention of Batrachian or Saurian reptile. There are thirty-six insects; of these, one is a beetle, one earwig, four ichneumons, one ant, three bees, one stone-fly, six butterflies, eight moths, two plant-bugs, four gnats, and five flies. The crustacea are sixteen in number, and the mollusca five. In the list it will be found there is a total absence of quadrumanous, feline, insectivorous, and edentate mammalia, and of zygodactyle birds; among the insects there is only one example of *Coleoptera*, one of *Orthoptera*, two of *Hemiptera*, and one of *Neuroptera*. The only new forms that occur are among the *Crustacea;* in these we have two genera, which we have not previously met with. Both of the new names given have been previously employed in entomology, so that they must fall, and others be instituted in their stead.

Catalogue of Animals described by Captain J. C. Ross as Natives of Boothia.

MAMMAL[illegible]IUS ANIMALS.

Ursus maritimus,	Polar bear
Gulo luscus,	wolverine
Mustela Erminea,	ermine
Canis lupus occidentalis,	American wolf
lagopus,	Arctic fox
Var. β. fuliginosus	
Arvicola Hudsonia,	Hudson's Bay Lemming
trimucronata,	Back's Lemming
Arctomys Parryi,	Parry's marmot
Lepus glacialis,	Polar hare
Cervus tarandus,	reindeer
Ovibos moschatus,	musk ox
Phoca fœtida,	rough seal
Greenlandica,	harp seal
Barbata,	great seal
Trichecus rosmarus,	Walrus
Delphinapterus beluga,	white whale
Monodon Monoceros,	norwhal
Balæna mysticetus,	black whale

BIRDS.

Falco Islandicus,	jerfalcon
Strix Nyctea,	snowy owl

* Philosophical Magazine, No. 47.

Alauda cornuta,	shore lark
Sylvia Œnanthe,	wheatear
Emberiza nivalis,	snow bunting
Plectrophanes lapponica,	Lapland finch
Corvus corax,	raven
Tetrao lagopus mutus,	Ptarmigan
saliceti,	willow grouse
rupestris,	rock grouse
Columba migratoria,	passenger pigeon
Charadrius semipalmatus,	American ring plover
pluvialis,	golden plover
Vanellus melanogaster,	grey lapwing
Strepsilas interpres,	turnstone
Grus Canadensis,	brown crane
Tringa maritima,	purple sandpiper
alpina,	American dunlin
Phalaropus fulicarius,	flat-billed phalarope
Sterna Arctica,	Arctic tern
Larus glaucus,	glaucous gull
argentatus,	black-winged silvery gull
leucopterus,	white-winged silvery gull
eburneus,	ivory gull
tridactylus,	kittiwake
Rossii,	cuneate tailed gull
Sabini,	fork tailed gull
Lestris pomarinus,	pomarine jager
parasiticus,	Arctic jager
Procellaria glacialis,	fulmar petrel
Somateria spectabilis,	king duck
mollissima,	eagle duck
Heralda glacialis,	long tailed duck
Anser bernicla,	brent goose
Hutchinsii,	Lesser Canada goose
Colymbus glacialis,	great northern diver
Arcticus,	black throated diver
septemtrionalis,	red throated diver

Uria Brunnichii,	Brunnich's guillemot
Grylle,	black guillemot
Alle,	little guillemot

FISHES.

Cyclopterus minutus	
Liparis communis	
Ophidium Parrii	
viride	
Gadus morrhua,	common cod fish
callarias	
Merlangus polaris	
Blennius polaris	
Cottus quadricornis	
polaris	
Pleuronectes hippoglossus,	halibut
Salmo Rossii,	Ross's Arctic salmon
alipes,	long finned char
nitidus,	angmalook
Hoodii,	masamacush

INSECTS.

Colymbetes mæstus,	[Dytiscites]
Forficula auricularia,	[common earwig]
Ichneumon lariæ,	[Ichneumonites]
Ephialtes,	[ditto]
Campoplex arcticus,	[ditto]
Microgaster unicolor,	[Braconites]
Myrmica rubra,	[Formicites]
Bombus Kirbiellus,	[Apites]
polaris,	[ditto]
Arcticus,	[ditto]
Tinodes hirtipes,	[Phryganites]
Colias Boothii,	[Papilionites]
Chione	[ditto]
Hipparchia Rossii,	[Papilionites]
subhyalina,	[ditto]
Melitæa Tarquinius,	[ditto]
Polyommatus Franklinii,	[ditto]
Laria Rossii,	[Arctictes]
Eyprepia hyperborea,	[ditto]
Hadena Richardsoni,	[Noctuites]

Psycophora Sabini, [Geometrites]
Oporabia punctipes
Orthotænia Bentleyana, [Tortricites]
septentriononа, [ditto]
Argyrotosa Parryana, [ditto]
Acanthia stellata, [Cincicites]
Pedeticus variegatus, [ditto]
Culex capsius, [Culicites]
Chironomus polaris, [ditto]
borealis, [ditto]
Tipula Arctica, [Tipulites]
Helophilus bilineatus [Helophilites]
Tachina hirta, [Muscites]
Anthomyia dubia, [ditto]
Scatophaga apicalis, [Scatophagites]
fucorum, [ditto]

CRUSTACEOUS ANIMALS.

Crangon Boreas, [Polar shrimp]
Sabinea septemcarinata
Hyppolyte aculeata
Sowerbii
borealis
polaris
Mysis flexuosus
Themisto Gaudichaudii
Gammarus nugax
ampulla
boreus
loricatus
Sabini
Amphithoë Edvardsi
Acanthonotus cristatus
Acanthosoma hystrix

MOLLUSCOUS ANIMALS.

Rossia palpebrosa
Clio borealis
Limnacina Arctica
Bothnia reniformis
Cystingia Griffinsii.

Polar Bear.—Our author mentions that, during their stay at Fury Beach, many of these animals came about them, which they killed. Some, tempted by the fine appearance of the meat, made a hearty meal of the first that was shot. All who partook complained of violent headache, which, with some, continued two or three days, and was followed by the skin pealing off the face, hands, and arms.

Wolverine.—At Victoria Harbour, two or three months before the ship was abandoned, they were surprised by a visit from one of these animals; it climbed the snow wall and came boldly on deck, where the crew were walking for exercise. He seized on a canister with some meat in it, and feasted so ravenously, that he allowed our author to slip a noose over his head, by which he was secured.

Wolf.—They are extremely troublesome to the Esquimaux. A single wolf will go amongst any number of Esquimaux dogs, and carry off one without any resistance on the part of the rest. These dogs have such an extreme dread of the wolf, that they tremble and howl when aware of its approach.

Arctic Fox.—In July, 1831, one of their burrows was found on the margin of a lake: it had several passages opening into a common cell, beyond which was an inner cell, containing six young ones. In the outer cell and passages were great numbers of lemming, ermine, and the bones of hares, fish, and ducks. Four of the cubs were kept alive, and became very tame.

Hudson's Bay Lemming.—It has been found in the highest latitude yet reached: it congregates in the summer by the sea shores, and breeds among the loose stones: in the winter it con-

structs a nest of dry grass on the surface of the earth, beneath the snow, and makes numerous passages from its nest, by which it roams in search of food, seldom appearing above the snow; if it happens to venture out, it burrows in the snow with such rapidity, on being disturbed, that it is seldom taken. Our author made a singular experiment on this animal. Having tamed one, and kept it in the cabin, he found it did not assume the usual coat of white, almost universally worn by the Arctic quadrupeds in winter; he therefore placed it on deck, in a temperature of thirty degrees below zero; in a single day the cheeks and a patch on each shoulder had become perfectly white. The following day the white had extended: the four following days it still continued increasing in white, and on the seventh day the animal was perfectly white, except a transverse mark on the shoulders, which was prolonged some way down the back, in the form of a saddle. On examining the fur, the white hairs were the longest, and were white at the tips only: on cliping it with scissors, it was as brown as before the change.

Polar Hare.—This animal is abundant in the polar regions, and appears to seek no shelter from the inclemency of the climate. It produces from four to eight young at a birth. If caught young, it is easily tamed: one taken in June, became tame enough to eat from the hand in a few days. It preferred to share the peas-soup, plum-pudding, bread, sugar, rice, and cheese, to the grass and herbs which had been prepared for it. It would not bear being caressed, but was fond of company; would sit for hours and listen to conversation, and retire to his cabin when it was ended.

Musk Ox.—The dung of the musk ox is considered a delicacy by the natives!

Rough Seal.—This is a most valuable animal to the Esquimaux, and hunting it is one of his chief occupations, when all other animals have migrated southward to avoid the extreme cold. The Esquimaux thus traverses, with his dogs, the extensive floes of level ice until they scent the breathing holes of these seals. As soon as a hole is found, the Esquimaux builds a snow wall, to break the excessive keenness of the breeze; he then waits in patience, with uplifted spear, till the seal rises to breathe, and smites him with unerring aim.

Fulmar Petrel.—This bird follows the whale-ships, availing itself of the labours of the fishermen, by feeding on the carcasses of the whale, when stripped of their blubber. In return, it is exceedingly useful to the whalers, by guiding them to the places where whales are most numerous, and crowding to the spots where they first appear on the surface of the water.

Ross's Arctic Salmon.—This and the three following species of salmon, are supposed by Dr. Richardson to be entirely new, and will be figured in the forthcoming part of his *Fauna Boreali-*

Americana. The length of this species is 34 inches; of *S. alipes*, 24 inches; of *S. nitidus*, 20 inches; and of *S. Hoodii*, 21 inches.

Ichneumon Lariæ.—This beautiful ichneumon is figured of a bright red colour; it was bred early in July, from the pupa of Laria Rossii: a second specimen was taken on the 8th of July.

Colias Chione.—A very remarkable looking butterfly, partaking very considerably of the appearance and colouring of the *Polyommati*. It appears in the middle of July, and frequents the flowers of *Oxytropis campestris*, and *Arctica*.

Melitæa Tarquinius.—Of this butterfly our author was fortunate enough to find the larva. The following is his description: it measured exactly an inch in length, by 0·22 of an inch in breadth; it was composed of thirteen segments; the first and last segments were furnished with two, the second and twelfth with four, and the remainder with six spines, dispersed in rows and equidistant on each side the back. The colour was dark brown, with a line of white spots along each side. A caterpillar, found under a stone, in the middle of march, perfectly hard frozen, showed symptoms of life in half an hour after being brought into the cabin, and in less than an hour was walking about the table.

Laria Rossii.—The caterpillars of this moth were the subject of the following experiment. Thirty of them were put in a box, and exposed to the winter temperature for three months; on bringing them into the cabin, every one of them returned to life and walked about; they were again exposed to an atmosphere of forty degrees below zero, and instantly became refrozen: after a week, they were brought again into the cabin, and twenty-three returned to life: these were again exposed, refrozen, and, after being solid for another week, eleven of them revived on being brought into the cabin; a fourth time they were frozen, and two only recovered; of these two, one produced a moth, the other six flies.

Culex caspius.—It appeared about the 10th of July, 15th became extremely numerous, and 22nd so troublesome as to prevent the necessary duties of the ship. They were in perfect clouds over the marshes, and these larvæ constitute the principal food of the trout in the lakes.

Acanthonotus cristatus.—This is a new and most singular genus of *Crustacea Amphipoda*. It is nearly allied to *Talitrus* of Latreille, and was first discovered during Parry's second voyage, near the island of Igloolik. In the course of the present voyage a few specimens were taken at Felix Harbour. We subjoin the generic character. Antennæ of nearly equal length, four-jointed; the terminal joint consisting of very many rings; the third joint of the superior antennæ short; the four anterior feet monodactyle, filiform, having in the first four the terminal joint serrated; rostrum produced, acute, incurved.

Acanthosoma hystrix.—This is a still more singular animal than the preceding, and is very distinct from anything we have seen. On each of the nine segments following the head are seven spines, forming seven longitudinal rows; there are two spines on the head, one on each side of the rostrum; on the tenth segment are five spines, and on the following one three only.

Rossia palpebrosa.—A new molluscous animal, described and figured by Mr. Owen in a manner that leaves nothing to be desired. The description has afforded us great pleasure; it is too long to extract, and too concise to abridge; we therefore entreat such of our readers as may possess a taste for anatomical detail to study the masterly production.

Limarina Arctica.—" A very abundant species, peopling as it were the Polar seas, and constituting the chief source of subsistence to the Greenland whale. It is indeed most truly wonderful that so small and apparently insignificant an animal can be made to fulfil the most important purposes: from the smaller species of crustacea to the enormous whale, all derive their food directly or indirectly from this little creature. It is, in fact, to the inhabitants of the Arctic ocean what the vegetable kingdom is to the inhabitants of the land—the foundation of animal existence."*

GORDIUS AQUATICUS.

By Dr. George Johnston, Berwick-upon-Tweed.

So much has been said of the *G. aquaticus*, and so very few of those who have written about it seem to know the animal, that I am tempted to give a figure, and some short account, of the veritable worm; which, though common enough, is less so than the *Filaria*, frequently mistaken for it.

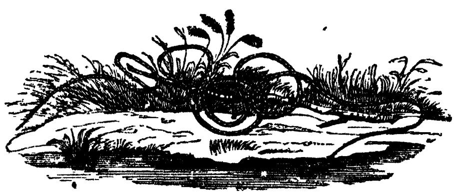
Synonymes.—Gordius pállidus; cauda capiteque nigris *Linn.*, Suec. 363: G. aquaticus *Lin.*, Turt. iv., 57; Turt. Brit. Faun., 130; Stew. Elem., ii., 353; Lam. Anim. s. Vert., iii., 220; Flem. Phil. Zool., ii., 605; Cuv. Reg. Anim., iii., 217; Baird in Hist. Berw. Nat. Club, p. 23.

Hab.—Slowly running and stagnant waters, in summer.

Desc.—The body is from 6 to 10 inches long, of the thickness of a hog's bristle, exactly filiform, rigid and incompressible, smooth, of a uniform blackish or yellowish brown colour, sometimes paler on the ventral surface, and the tips always a shade darker. The head is obtusely conical, with a simple circular terminal pore for a mouth, from which a sort of membrane can be forced by pressure. The skin is smooth, minutely areolar, as is very evident when it is partially dried, and marked with a few obscure circular plaits, perhaps produced by the process of dry-

* Entomological Magazine, No. 15.

ing. Within an inch of the tail, there is a small space, which is roughened on the sides with very minute granules. The tail is bifid, the processes short, equal, and obtuse. The anus is apparently not terminal, but placed a little above. The interior of the body is occupied by a milk-white and comparatively large intestine, which runs from one extremity to the other. When cut through, within an inch of the head, no fluid escapes; but, when a like portion was cut off from the tail, a milky and somewhat oily liquor oozed out. The intestine seems to be annular, for its sides have a crenulated appearance under the magnifier.



(Gordius Aquaticus.)

This singular worm is in perpetual motion and change; and its wrigglings have a sort of painful character, which suggest involuntarily a comparison of it to "the worm that never dieth." Although observed very often during several days, it was never seen at rest for a single moment, but was ever bending its long hair-like body into larger and smaller curves, now moving rapidly across the plate, and now twisting and contorting itself into circles and curves. The undivided end, though the contrary has been asserted,* is evidently the head: and this part is often pushed forward and out of the water; which, however, the worm never leaves. When a portion from the anterior end was cut off, the detached portion very soon lost every sign of life. A portion from the tail gave evidence of remaining irritability for a longer time, but still did not live long; the main part, however, continuing to move on as before; and, as it did so for at least 48 hours, it may be that life would not have been shortened by these mutilations.

The synonymes and descriptions of this worm are exceedingly confused; for many authors have not distinguished it from the *Filaria*; a worm very like the *Gordius*, and sometimes found in the same places, though its proper habitat is in the intestines of beetles and other insects. Thus, Müller has described the *Filaria* for his *Gordius seta*, and has given the *G. aquaticus* as a variety of this; and, from the fact that few authors have noticed

* Dr. Turton describes the tail as a mouth, which, he says, is "small, horizontal, with equal, obtuse jaws."

the bifid tail, we may infer that they generally have had the *Filaria* in view.

The *Gordius*, we are told by certain authors, perforates clay to give a passage to springs and water! By others it is said to kill fishes; and, to man, to be so far noxious, that its bite occasions inflammation, which may be cured, it is kindly added, with opium! Such is a specimen of the fancies which disfigure the history of worms, and which are still to be found in works of a scientific pretension, where we expect to find nothing but the deductions of observation. The stories of the rustic naturalist are, however, not only allowable, but amusing. The country people of Smöland believe that the bite of the *Gordius* causes the whitlow, and they give to the worm and the disease the same name: acting on this belief, they cure the disease by making an incision into the part with a knife, which must have been previously used in cutting the worm itself into pieces. Our own country people are convinced that the *Gordius* is merely a horse-hair animated by being steeped in water; and, if you hesitate to believe the story, they will tell you, as I have been told repeatedly, that they have often, in their boyish days, performed the experiment with success, having been witnesses to the fact of the hair growing into the living worm. Stanihurst, in his account of Ireland, adduces it as an example of animals "ingendred without seed,"—"and chieflie by the secret influence and instillation of the celestial planets, as the sunne and such other; as, if you put the haire of an horse taille in mire, puddle, or in a dunghill, for a certain space, it will turne to a little thin spralling worme, *which I have often seene and experimented.*"

Linnæus tells us, that the rustics of Smöland say, that all the pieces of the worm of this kind that have been divided into many, on being kept immersed in water, will each grow into a perfect body. On this slender authority, apparently, other less cautious naturalists have stated this as a fact; but the circumstances observed by us in our experiments would appear to militate against its truth.*

EHRENBERG'S NEW DISCOVERY IN PALÆONTOLOGY—TRIPOLI COMPOSED WHOLLY OF INFUSORIAL EXUVIÆ.

At the Royal Academy of Sciences of Paris, July 11th, the following letter was communicated, dated Berlin the 3rd of July, from M. Alexander Brongniart:—"I have to-day become acquainted with a discovery entirely new, for which we are indebted to M. Ehrenberg, and which he has demonstrated to me in the clearest manner; it is, that the rocks of homogeneous appearance, which are not very hard, friable, even fissile, entirely

* Magazine of Natural History, No. 63.

formed of silex, and which are known by the name of tripoli, more or less solid (*Polierschiefer* of Werner), are entirely composed of the exuviæ, or rather of the perfectly ascertained skeletons of infusorial animals of the family of the *Bacillariæ*, and of the genera *Cocconema*, *Gomphonema*, *Synedra*, *Gaillonella*, &c. These remains having perfectly preserved the forms of the siliceous carcasses of these infusoria, may be seen with the greatest clearness through the microscope, and may easily be compared with living species, observed and accurately drawn by M. Ehrenberg. In many cases there are no appreciable distinctions. The species are distinguished by the form, and still more surely by the number of *septa* or transverse lines which divide their small body; and M. Ehrenberg, who has been able to count them by the microscope, has observed the same number of these divisions in living and in fossil species. They are the tripolis of Bilin in Bohemia, of Santa-Foria in Tuscany, and of other places which I do not remember with certainty, (of the Isle of France, and of Francisbad, near Eger, if I am not mistaken,) which had given occasion to these curious observations. The slimy iron-ore of marshes is almost wholly composed of *Gaillonella ferruginea*. The greater part of these species are lacustrine, but there are also some marine, particularly in the tripoli of the Isle of France."*

Professor Jameson and Mr. Nicol have examined carefully characteristic specimens of polishing-slate (*Polierschiefer*,) and found in them numerous remains of lacustrine infusoria, thus confirming the discovery of Ehrenberg, in so far as it applies to the Polier-slate.†

THE WHITE BAIT, (CLUPEA ALBA, YARRELL,) IN THE FRITH OF FORTH, AND AT KINCARDINE.

At the meeting of the Wernerian Natural History Society of Edinburgh, held on March 12, Dr. Richard Parnell made an interesting communication regarding the occurrence, in the Frith of Forth, of the noted little fish called white bait, on which Londoners are wont to feast at Blackwall. Much dubiety has long prevailed concerning this fish; English naturalists having considered it as the fry of the shad; and those of Edinburgh having overlooked it as the young of the sprat or garvey herring. It is now viewed by Mr. Yarrell as a distinct species, and is called Clùpea álba, from its prevailing white colour. Dr. Parnell exhibited recent specimens from the Forth, and also from the Thames; and he minutely detailed the characteristic marks of distinction between it and the sprat and the young of the common herring, to the entire satisfaction of Professor Jameson,

* L'Institut, No. 166.

† Jameson's Journal, No. 42.

Mr. Wilson, Mr. Stark, Dr. Neill, and other naturalists present. Dr. Parnell observed the white bait plentiful at the stake-nets at South Queensferry. It is likewise common at Kincardine, being constantly entangled in the sprat or garvey-herring cruives, but hitherto neglected on account of its diminutive size. If the Scottish fishermen were taught to discriminate the white bait, and were encouraged to send it in quantity to the Edinburgh market, they might find in it a new source of income, equal or superior to the spirling or smelt fishery. The most obvious marks consist in the very small size, the white bait of the Forth seldom exceeding 2 in. or 3 in. in length; in the brilliant whiteness of its sides; in the body being thinner, or more compressed; and in the head being proportionally longer than in the garvey-herring, or in the fry of the common herring.*

METAMORPHOSIS OF CRUSTACEA.

On February 4, was read before the Royal Society, a "Memoir on the Metamorphoses, in the *Macroura*, or Long-tailed Crustacea, exemplified in the Prawn (*Palæmon serratus*)." By John V. Thompson, Esq., F L S., Deputy Inspector-General of Hospitals. Communicated by Sir James Macgrigor, M.D., F.R.S., &c.

The author gives descriptions, illustrated by outline figures, of three different stages of growth of the Prawn; the first being that of the larva immediately on its exclusion from the egg; the second, at a later period, when it has acquired an additional pair of left members, and a pair of scales on each side of the tail; and the third, at a still more advanced age of developement, when it presents the general appearance of the adult Prawn, but still retains the natatory division of the members, now increased to six pairs. The author thinks it probable that an intermediate stage of metamorphosis exists between the two last of these observed conditions of the animal."†

THE AMERICAN COW BUNTING.

In the *Magazine of Natural History*, No. 58, will be found a very interesting paper on the habits of the Cow Bunting of the United States, by George Ord, Esq., of Pennsylvania. The paper extends to sixteen pages, and is concluded with the following summary of the peculiarities of this anomalous bird:—

1st. There are sometimes two eggs of the cow bunting deposited in the same nest.

2nd. The cow bunting sometimes drops her egg in the nest of a bird larger than herself.

* Magazine of Natural History, No. 62.
† Philosophical Magazine, No. 48.

3rd. The egg of the cow bunting requires the same term of incubation as that of the foster-parent.

4th. The eggs of the foster-parent are never removed from the nest, but hatch as in ordinary cases.

5th. When two eggs of the cow bunting are hatched in the nest of a bird smaller than herself, the young of the foster-bird, for the want of room, are either smothered in the nest, or jostled out of it.

6th. When only one egg of the cow bunting is hatched in the nest of a bird smaller than herself, the young cow bird, and the young of the owner of the nest, are nourished and reared with equal affection, and dwell in harmony together.

7th. When the cow bunting drops her egg in the nest of a bird larger than herself, the selected nurse does not eject the egg, but hatches the stranger, and nourishes it as her own.

8th. The cow bunting will drop her egg into a nest which contains more than one egg.

A SPECIES OF COCCINELLA NEW TO BRITAIN. C.M.-NIGRUM OF FABRICIUS.

The entire upper surface testaceous, occasionally varying, probably in immature specimens, to a dirty white; the eyes and divers spots on the head varying in different specimens, nearly black: prothorax, dirty white, with an undulated black line in the form of a W, the component parts of the W sometimes wanting connexion: elytra testaceous, the hue exceedingly variable in different specimens; each has on the disc a dark longitudinal line, frequently interrupted in the middle; this line in many specimens is totally wanting. The under surface is dark brown, anteriorly approaching to black: the legs are entirely pale. The size is precisely that of *C. variabilis*, but the form more oblong.

Beaten in some abundance from the larch on Lady Rodney's estate at Berrington, in Herefordshire, during the second week in May, 1836. Eighteen specimens, of which no two are precisely similar, are preserved in the cabinet of the Entomological Club.*

ON THE CHANGES WHICH THE STOMACHS OF CRABS UNDERGO DURING THE PERIOD OF CASTING THEIR SHELLS.

A very accurate account of these changes is given by Dr. K. E. V. Baer, in the sixth number of Müller's Archiv. 1834. Crabs, it is well known, change their shells at a certain season of the year; and it is a very old opinion that they change their stomachs at the same time, a new stomach being formed round

* Entomological Magazine, No. 16.

the old, which is digested by the recently developed organ. Baer has proved that the crab's stomach consists of two coats; one inner, which in every respect may be compared to a callous, horny epidermis, and which is destitute of vitality; and an outer or containing coat, transparent, but sufficiently strong and vascular. The inner coat, as it is well known consists of various and very curious parts, some resembling bony plates, others compared to teeth; now at the period when the crab changes its skin, it likewise casts the inner coat of the stomach, and on this account this process, analogous to the moulting of birds, and to the renewing of the hair in quadrupeds, is in the crab attended with very great constitutional disturbance, and a total interruption of the digestive function. Baer relates very accurately the changes which the stomach undergoes preparatory to the casting of its inner coat. It would be beside our present purpose to follow him in this description, however interesting. Some things he mentions are, however, specially worthy of remark; in the first place the softer parts of the old epidermis or inner coat of the stomach are very rapidly digested in the stomach, as soon as it has recovered its functions, and has, which it does quickly, formed a new lining on its inner surface. But there are other harder parts that cannot be so readily digested and dissolved, and which are otherwise disposed of. The hard and hollow bones, popularly termed the teeth, are got rid of by being discharged through the external orifice corresponding to the mouth. There are other solid plates of the epidermic portion of the stomach, which are not of a shape calculated to irritate the new and tender epidermis, and consequently they can be retained with impunity, and are destined to perform a new and curious function, for according to Baer, these plates, for some time preparatory to the act of casting the shells, rapidly increase in weight and in solidity, so as at the period we are speaking, they may be considered as forming considerable reservoirs of earthy matter, to be gradually dissolved and digested in the newly lined stomach, at the very time earthy matter is required by the animal for the formation of its new shell. These plates are popularly called *crab-stones*, and when submitted to the digestive process soon lose their roughness, and become smooth and polished before they are entirely dissolved. These crab-stones are chiefly composed of carbonate of lime, and Baer has proved, by repeated analyses, that the fluid contents of a crab's stomach contain (at the time these stones are in them) a considerable portion of lime, carbonic acid, and muriatic acid. It is interesting to observe, that the chemical investigations of Dulk, render it highly probable, that the chief solvent in the crab's stomach is the same acid which plays so important a part in human digestion and in dyspepsia, viz. *free muriatic acid.**

* Jameson's Journal, No. 42.

ST. JAMES'S ORNITHOLOGICAL SOCIETY.

THIS Society is instituted for the purpose of forming a collection of water-birds in the garden of St. James's Park; and its operations will subsequently be extended to the waters in the other parks, if the funds of the society be found sufficient. The first object will be to exhibit a complete collection of British *Anatidæ*, both resident and migratory. The society already possesses a considerable number of the desired species, and has, besides, some specimens belonging to other genera. It is intended to keep the whole, as far as practicable, in a state of nature, and the collection, being formed in the public parks, will, of course, be open to the view of every one.

As there is in London no other exclusively Ornithological Society, it is unnecessary to point out to the ornithologist the advantages which may result from an institution possessed of a locality so admirably calculated for a collection of aquatic birds, and for affording facilities for observations on the changes of plumage from sex, age, or season, which are so interesting to naturalists, and so difficult to be observed elsewhere. It is, moreover, to be hoped that the society will not direct exclusive attention to the formation of a collection of aquatic birds, but that the members will take into consideration the whole range of ornithology, have meetings for the reading of lectures and essays, and for discussions on topics relating to the science. It might then, if well conducted, and with the addition of a good library and museum, become one of the most useful natural history societies in existence.

It is not, however, to the scientific alone that the society appeals for support; it confidently addresses itself to all lovers of the beauties of nature; to all who can appreciate the charm which the feathered race, the most beautiful portion of the animate creation, are capable of lending to ornamental water. To render the proposed collection worthy of the metropolis and the scene, will require a considerable expenditure, but the amount of annual subscriptions, (which are usually 1*l*.,) is rapidly increasing, and presents of aquatic birds continue to be received. The proceedings of the society are sanctioned by the Commissioners of Woods and Forests; the Earl of Liverpool is president.*

NESTS OF THE COMMON WASP.

By a Correspondent of the Entomological Magazine, No. 18.

IT is necessary to observe, that the nests of this insect are situated in banks, and sometimes a considerable distance from the surface. The best mode is to attack them by night, putting into the external aperture a lighted fusee, composed of moistened gunpowder

* The Analyst, No. 18.

mixed with sulphur and saltpetre. After this has been in the nest about five minutes, the wasps become so stupified with the fumes of the powder, that the nest may be dug out in perfect safety. Great care should now be taken not to cut the nest with the spade; it is frequently so large that there is great danger of this. After the nest is obtained, it is best to bring it home in a bag, carefully tied up, as the wasps are very tenaceous of life, and soon recover from the effects of the powder.

No. 1.—This specimen was nearly of a globular form: it contained seven plates, placed horizontally above each other; the central one was the largest, and the others gradually diminished in size. The plates were supported by rudely-constructed pillars placed at irregular distances from each other, and composed of the same material as the plates themselves, a material resembling pulverized decayed leaves. The purpose of these pillars is to support the plates, and keep them at an equal distance from each other, so that the working wasps can freely visit all parts of the nest. The plates are divided into numerous inverted hexagonal cells, in each of which is deposited an egg of an oblong form, attached to the side, nearly at the bottom, by a glutinous matter, which envelopes it at the period of its extrusion. From the egg is produced the white larva, which is so favourite a bait with fishermen; after this has been fed by the working wasps for a few days, it is covered in by them with a substance resembling whity-brown paper, and becomes a pupa, which resembles the larva in being perfectly white.

The cells do not, as might be supposed, contain, indifferently, males, females, and neuters on the same plate, but each kind is confined to a separate plate, one containing all males and neuters, and another all females. Those plates which contain the females are very readily distinguished from the others, by the superior size of the cells. Having observed a number of worm-like substances at the bottom of the cells, I was at a loss to know what they could be. It struck me they might have some reference to the black streak contained in each larva. On dissecting several larva I found that this streak was the intestinal canal; and I further learned, from the dissection of pupæ, that they were entirely without the black streak. On carefully examining the cells, I found that each of the cells in which were pupæ possessed one of the worm-like substances, and that the cells in which there were larvæ were invariably without them. I therefore conclude, that this substance is the contents of the intestinal canal, discharged at the time of transformation from the larva to the pupa state.

No. 2 contains but five plates, the central one the largest, as before, and all of them somewhat convex; the plates were supported by pillars of much less strength than those of No. 1. The substance of which the nest was constructed was of a lighter colour, and there was but one single perfect female in the whole hive. In every other respect this nest agreed with No. 1. On

examining the perfect insects, I found them to belong to a totally different species from *V. vulgaris*; they were smaller, and of a brighter colour. As I was examining the cells of this nest, one of those which had been covered in was gently opened, and the black antennæ of a male *Ripiphorus paradoxus* protruded through the opening. Its appearance in immerging was truly singular: first the antennæ, then the head, the thorax, and abdomen; at last, when quite clear of its prison, it ran about with amazing celerity. I had shortly afterwards the pleasure of seeing a female *Ripiphorus* escape in the same manner.

No. 3 was, in every respect, similar to No. 1, containing seven plates, and of this the perfect insect was the common wasp.

No. 4 was also similar, and was an amazingly large specimen, the central plate measuring upwards of fourteen inches in diameter. The larvæ, when in a state of rest, lay with their heads bent somewhat downward, but on moving any thing, before the cell which contains them, they stretch out their necks and open their mouths, reminding you of a nest of young birds. If a fly or piece of bread is given them, they emit a small portion of very transparent fluid from the mouth, and then attempt to eat, but I could never ascertain that the food diminished.

ON THE BRAIN OF THE NEGRO, COMPARED WITH THAT OF THE EUROPEAN AND THE OURANG-OUTANG.

By Frederick Tidemann, M.D., Professor of Anatomy and Physiology in the University of Heidelberg.

It has long been the prevailing opinion among naturalists that the Negro race is inferior, both in the organization and in intellectual powers, to the European; and that, in all the points of difference, it exhibits an approach to the Monkey tribes. The object of the present paper is to institute a rigid inquiry into the validity of this opinion. The author has, for this purpose, examined an immense number of brains of persons of different sexes, of various ages, and belonging to different varieties of the human race, both by ascertaining their exact weight, and also by accurate measurement of the capacity of the cavity of the cranium; and has arrived at the following conclusions:—The weight of the brain of an adult male European varies from 3 lbs. 3 oz. to 4 lbs. 11 oz. troy weight: that of the female weighs, on an average, from 4 to 8 oz. less than that of the male. The brain usually attains its full dimensions at the age of seven or eight; and decreases in size in old age. At the time of birth, the brain bears a larger proportion to the size of the body than at any subsequent period of life, being then as one sixth of the total weight; at two years of age it is one fourteenth; at three, one eighteenth; at fifteen, one twenty-fourth; and in the adult period, that is, from the age of twenty to that of seventy, it is generally within the

limits of one thirty-fifth and one forty-fifth. In the case of adults, however, this proportion is much regulated by the condition of the body as to corpulence; being in thin persons from one twenty-second to one twenty-seventh, and in fat persons often only one fiftieth, or even one hundredth of the total weight of the body. The brain has been found to be particularly large in some individuals possessed of extraordinary mental capacity. No perceptible difference exists either in the average weight or the average size of the brain of the Negro and of the European: and the nerves are not larger, relatively to the size of the brain, in the former than in the latter. In the external form of the brain of the Negro a very slight difference only can be traced from that of the European; but there is absolutely no difference whatsoever in its internal structure, nor does the Negro brain exhibit any greater resemblance to that of the ourang-outang than the brain of the European, excepting, perhaps, in the more symmetrical disposition of its convolutions.

Many of the results which the author has thus deduced from his researches are at variance with the received opinions relative to the presumed inferiority of the Negro structure, both in the conformation and in the relative dimensions of the brain; and he ascribes the erroneous notions which have been hitherto entertained on these subjects, chiefly to prejudice created by the circumstance that the facial angle in the Negro is smaller than in the European, and consequently makes, in this respect, an approach to that of the ape, in which it is still farther diminished. The author denies that there is any innate difference in the intellectual faculties of these two varieties of the human race; and maintains that the apparent inferiority of the Negro is altogether the result of the demoralizing influence of slavery, and of the long-continued oppression and cruelty which have been exercised towards this unhappy portion of mankind by their more early civilized, and consequently more successful competitors for the dominion of the world.*

BIRDS OF NORTHERN INDIA.

On March 26th, at the Wernerian Society, Professor Jameson exhibited a series of birds from Northern India, collected by Mr. Hamilton Stirling, which, he remarked, was remarkably interesting, as presenting many species which were not known to exist in that quarter. Mr. William Jameson pointed out several of these; of the rapacious order he noticed the Milvus govinda, and Accipiter dukhunensis, the former of which was considered to be probably the young of the Falco Cheela. With regard to the geographic distribution of the genus Milvus, it was stated, that it occurs in all the different continents of the Old World and New

* Proceedings of the Royal Society; Philosophical Magazine, No. 57.

Holland, but that it has not as yet been detected in the New World, its place being there supplied by the genus Nauclerus. Specimens of the Gypaetos barbatus were again laid before the Society, Professor Jameson having many years ago exhibited this bird sent from Northern India by Lieutenant Tytler (which, since that time, has been discovered by other travellers), for the purpose of pointing it out under the form of the Vultur Niger, it in the young state being considered as a distinct species, and described under this name; and also for the purpose of showing that it from the nest upwards, undergoes the same changes as the European species, a character, before all others, marking them to be one and the same species. In regard to British birds in general, in connexion with Indian ornithology, Mr. Jameson stated, that more than one-third of them occur in India, either identical with, or undergoing certain slight modifications in the colour of the plumage, size, &c., characters which, if their habits and manners are the same, would lead him to consider them rather as marked varieties than as new species. To the diurnal rapacious birds Mr. Jameson particularly directed the attention of the Society, and stated, that of the 18 diurnal birds of prey found in this island, the following striking distribution was presented, viz. In common with Europe 3; Europe and Asia 2; Europe, Asia, and New Holland, 1; Europe, Asia, Africa, and New Holland 3; Europe, Asia, and North America 5; if, however, the Circus cineraceus exists in North America, which is not at all improbable, we shall have 6; Europe, Asia, and South America 1; Europe and North America 3. To these conclusions, Mr. Jameson remarked, he had come, principally from an examination of the magnificent collection in the Museum of the University of Edinburgh. After some other general observations on the identity of particular species of rapacious birds, in which it was stated, that the Falco cherrug of Gray, is the female of the Falco islandicus; the Circus pallidus, Sykes, the young male of the Circus cyaneus; the Circus variegatus, the Circus rufus, &c.; Mr. Jameson exhibited specimens of the Gallus bankiva in its various stages, and remarked, that it is probably one of the originals of the domestic fowl, which seems to have originated not from one, but from many species; Bucco grandis; Phasianus albo-cristatus in its various stages; Parus (Leiothrix) furcatus, Temminck; Cinclus Pallasii, Temminck. With regard to the characters assigned to the genus Leiothrix by Swainson, of which the Parus furcatus is the type, and which has been justly separated from the true Pariadæ, some observations were made, showing that several of these are quite inapplicable to the type of the genus. In exhibiting the Cinclus Pallasii, Mr. Jameson remarked, that the genus was confined for many years to but one species, the existence of the Pallas dipper being called in question, and that not found out of Europe. Now however, we have three, and probably a fourth (a bird existing in the collection of the University of Edinburgh, which may be

placed in this genus, or rather forms a connecting link between the genus Cinclus and that of Pitta), some of which are found in all the great continents of the world, with the exception of New Holland. That the Cinclus pallasii is the same as the Cinclus Americanus, an opinion advocated by L. Bonaparte, can only be maintained by those who have not had an opportunity of comparing the two species, being very apt to be misled by the meagre description of the former by Temminck; one character alone, distinguishes the two species, viz. the Pallas dipper is more than a third larger than the American; moreover, the latter never assumes the colour of the former, at least Mr. Jameson was unable to detect, in a series of specimens of the Cinclus Americanus, in the Museum of the University of Edinburgh, the slightest approach to the tinge of colour assumed by the Pallas dipper. A specimen of Wryneck (Yunx torquilla) was exhibited, which was killed in February last in Fifeshire.*

ON THE RESPIRATION OF INSECTS.

By George Newport, Esq.

ALTHOUGH a multitude of facts has been collected relating to the physiology of respiration in insects, attention has seldom been directed to the variations exhibited in this function in the different periods of their existence. The author gives an account, in this paper, of the anatomical and physiological peculiarities which he has noticed in various insects, in their three states of larva, pupa, and imago. He traces all the several changes which the tracheæ and spiracles undergo during their transformations; describing particularly the succesive developement of the air vesicles in connexion with the power of flight. The system of muscles, both of inspiration and of expiration, is minutely detailed, and their various modes of action examined. He next investigates the series of nerves appropriated to the exercise of the respiratory function, and establishes a distinction in the offices of these nerves, corresponding to the sources from which they derive their origin, and presenting remarkable analogies with similar distinctions in the nerves of vertebrate animals. The manner in which respiration is performed, and the phænomena presented with regard to this function under various circumstances, such as submersion, and confinement in unrespirable or deleterious gases, are next considered. An account is then given of a series of experiments made with a view to determine the quantity of oxygen consumed, and of carbonic acid produced, by the respiration of various kinds of insects in different states, from which the conclusion is drawn that the quantity of air deteriorated is governed by several circumstances not necessarily connected with the natural habits of the species. When the insect is in its pupa state, and in com-

* Jameson's Journal, No. 41.

plete hybernation, its respiration is at its minimum of energy: and, on the contrary, it is at its maximum when the insect is in the imago state, and in the condition of greatest activity.

In the concluding section of the paper the author institutes an inquiry into the capabilities which insects possess of supporting life, during longer or shorter periods, when immersed in different media; and gives a tabular view of the results of numerous experiments which he made on this subject. It appears from these observations that the order in which these media possess the power of extinguishing vitality is the following: viz. hydrogen, water, carbonic acid, nitrous acid gas, chlorine, and cyanogen. Some of these agents, however, affect respiration much more rapidly than others, which, though their action is slower, are eventually more fatal to the insect.*

COLASPIS BARBARA.

On August 3rd, M. Duponchel read a letter to the Entomological Society of France, which had been addressed to him by M. Daube, a member of the Society, on the subject of *Colaspis barbara*, Fab. "It were much to be desired," said the writer, "that the insects in question, denounced previously in the '*Annales*' as injurious to farmers, were confined to the kingdom of Valence; every year our lucern, after the first cutting (that is to say in the month of June), is devoured by the larvæ of this insect. If, instead of collecting the larvæ in a net, as is the present practice, they were to collect and destroy the perfect female, there is no doubt but a better result would follow. Indeed from a plant so bushy as the lucern, one can only sweep into the net those larvæ which happen to be on the tops: and as the larvæ fall at the least movement of the plant, it is very difficult to destroy any considerable number, even though the operation be continued repeatedly. I employ the following plan, which I consider every way preferrable; for if it does not entirely destroy the evil, it undoubtedly greatly abates it. The *Colaspis barbara* begins to appear in the beginning of May. At this period they may be found *in copula*, and closely adhering to the stem of the lucern. Some days after, the males disappear, and the females, with bodies remarkably increased in size, being no longer able to use their wings, run hither and thither to deposit their eggs. The laying of eggs continues from eight o'clock in the morning till between two and three in the afternoon. Nothing is more easy than to take the females during the operation; for they lay the eggs at the very tips of the lucern, and the enlargement of their bodies renders them very conspicuous. Every female lays, in my opinion, about 500 eggs; now, if a woman were employed in collecting them, supposing she gathered but 2,000 per day, it is evident

* Philosophical Magazine, No. 57.

how many would be destroyed, for the period of oviposition lasts but from ten to twelve days. I had this year a field of lucern inclosed by walls; and perceiving that the lucern in the neighbourhood was already becoming a prey to this insect, I employed a woman, who, in eight days, collected from thirty-five to forty kilogrammes of the females. By this means I have had the pleasure of cutting a hundred *quintals* of lucern at a time, when the crops of my neighbours have been entirely destroyed. Having no longer any thing to eat, the larvæ attacked the santfoin, and even the wheat. M. Daube, in the same communication, mentions the injury done to the vines by *Altica oleracea*, which, for ten or eleven years, has been the scourge of the neighbourhood of Montpelier. Great quantities of them are destroyed every year; in one district alone they collected a hundred *quintals*. The perfect insect gnaws the buds, and the larvæ eat the leaves and the grapes."*

ZOOLOGY OF NORTH AMERICA.

At the anniversary of the British Association, Dr. Richardson read his Report on the Zoology of North America.

It did not appear probable that the progress of colonization had, as yet, extinguished any one species of animal from the country. The great similarity which existed between the animals of North America and those of Europe, as regarded their generic distinctions, connected with the dissimilarity of their species, rendered them well adapted to inquiries connected with their respective geographic distribution. Hitherto the trivial names bestowed by the colonists upon many of those of North America, had tended to mislead naturalists. The observations in the present report would principally refer to the western parts of North America, including New Mexico, the Peninsula of Florida and California, down to the well-defined limits of the South American zoological province.

In touching upon the geographical distribution of the Mammalia, Dr. Richardson remarked, the great similarity which existed between them and the European species; whilst there was the greatest dissimilarity to those of South America. The boundary line separating the Faunas of North and South America, was not at the Isthmus of Darien, but at the tropic of Cancer. No Quadrumana occur to the north of the Isthmus of Darien; though in Europe there is a species which ranges as far north as the rock of Gibraltar, in latitude 36°.—In the order of Carnivora, and family Cheiroptera, all the North American species belong to that tribe which possesses only one bony phalanx in the index, and two in each of the other fingers, to which tribe also all the European bats belong, except an Italian species of Dinops. None of the sixteen species recorded as natives of North America have been found elsewhere; two only have been traced over any great extent of country, and one of these (resembling the European Pipistrellus) ranges through 24° of latitude, and is the most northerly species in America. There must be still many bats to be dis-

* Entomological Magazine, No 18.

covered in that country, as those of Mexico, California, and the whole track of the Rocky Mountains, are entirely unknown. Of the family Insectivora, ten species were enumerated; and it was stated that North America differs more from Europe in this family, than in any other of the order Carnivora. Three of the European genera do not exist in North America, and the three genera found in North America do not exist in South America. The North American species of Sorex, however, closely resemble those of Europe.—Of the family Marsupiata, inhabiting the New World, only three species reach into North America, the rest being confined to the south of the Isthmus of Darien. Two of these occur no higher than Mexico; but the third, (the Virginian opossum,) ranges to the great Canadian lakes on the north, and to Paraguay on the south.—About forty species of the family Carnivora have been noticed; and this family includes a greater number than any other which are common to both North America and Europe; though possibly a closer acquaintance with some which are at present considered identical, may enable us to establish some distinction between them. The generic forms of North America are the same as those of Europe, excepting in a very few cases, which belong to the South American group. A few of the more northern forms also cross the Isthmus of Darien to the south.—In the family Plantigrada, two of the four bears of North America are undoubtedly peculiar to the New World; and one of these is the most northerly quadruped it contains. The American Glutton, or Wolverine according to Cuvier, is identical with that of the Old World. Among the Digitigrada, the range of the Mustelæ is limited southwards to the northern or middle districts of the United States. Whether any of the American and European species of this genus be really identical, is involved in great uncertainty. Of the three Otters of North America, one appears to be identical with that of Europe; and another, if correctly identified as the *Lutra Brasiliensis*, has a most extensive range, from the Arctic Sea through great part of South America. Eight species of the genus Canis are found in North America; but there is great difficulty in distinguishing the species, and in identifying them with any of those of Europe. The domestic dog breeds with the wolf and fox, and their offspring is prolific. Eight species of the genus Felis were mentioned by Dr. Richardson, three of which extend from South America into the south-western territories of the United States; and some of the others are still doubtful as North American species. The nine species of Amphibia found in North America, are mostly common to the northern seas of the Old and New Worlds: the genus Otaria alone being confined to the North Pacific; and even these range to the Asiatic coast. The specific identity of some of the seals is involved in very great doubt. In the order Rodentia, there have been between seventy and eighty species discovered; and here North America surpasses every quarter of the globe in the abundance and variety of form which these animals assume. The squirrels are not yet satisfactorily determined. The marmots are numerous, except in the subgenus Spermophilus. There is only one which may possibly be common to the New and Old World. There is only one of the restricted genus Mus, which is unequivocally indigenous to North America; and this closely resembles the European *M. sylvestris*. Other species have been introduced from the opposite side of the Atlantic.

The order Edentata is eminently South American, and only three or four species are met with in North America. The fossil species of Megatherium and Megalonyx, however, are found in both Americas.—The

order Pachydermata is remakable for the size of most of its species, and the number of the extinct species is more than double the recent ones in the New World. Only two genera and three or four species belong both to North and South America. Fossil elephants and mastodons occur in the most distant parts of North America. Although the present race of horses is certainly of European origin, yet fossil bones of this quadruped are met with in Kotzebue's Sound.—Thirteen species of Ruminantia were enumerated, two of which are common to the old and new continents, and have a high northerly range. The North American deer are very imperfectly known. The reindeer reach to Spitzbergen and the most northerly of the American islands, and range southwards as far as Columbia River on the Pacific coast, and to New Brunswick on the Atlantic. Although the musk-ox ranges from the barren lands over the ice to Parry's Islands, it is not found either in Asia or Greenland.—There appears to be nine species of Cetacea, known as North American, and those on the east coast are mostly inhabitants of Europe also, under the same parallels of latitude, especially those of the Greenland seas. On the western side the species are common to Asia also.

The report proceeded with the Ornithology, which Dr. Richardson said it would be unnecessary to touch upon at so great length or with so much detail as the Mammalia, since the species were so much better known, a great majority of them being migratory, and therefore those which lived in the less frequented regions were, at stated seasons, visitants of the more civilized districts. Local lists, however, were still wanting to enable naturalists to trace their geographical limits with precision, and, more especially, our knowledge was very imperfect of those of California and Russian America. Of about 500 species, there were one-fourth to be found in Europe, but not more than one-eighth in South America. Of the former, or those common to North America and Europe, thirty-nine were land-birds, twenty-eight waders, and sixty-two water-birds. Several of the generic forms were peculiar, but only two of the families, viz. the Trochilidæ and Psittacidæ, were not to be found in Europe; and the Hoopoe is the only European representative of the whole order to which the former of these families belongs.—No Vultures are common to both worlds, but nearly half the other birds of prey are so, and many of these range over South America also, and indeed the whole world. One-fourth of the Corvidæ are inhabitants of Europe; but the other land-birds, common to both continents, are in much smaller proportions, and not more than two out of sixty-two Sylviadæ are European. The number of species common to North and South America is very uncertain. Some of the most numerous families characteristic of the former country have few or no species in South America, it is remarkable that only one Trochilus has been described as common to North and South America, although this family is peculiarly characteristic of the latter country; and there are twenty-two species which have been described as natives of Mexico. Dr. Richardson then detailed several particulars respecting the migration of birds, stating it to be his opinion, that the spring movement was for the purpose of finding a convenient place for incubation and rearing the young. The lines of rout were influenced by the supply of food to be obtained, and thus the northerly and southerly courses were often over different tracts; and he pointed out the three great lines of route which were to a certain extent determined by the physical features of the country. The absolute number of birds to be found in different countries decreases on receding from the Equator towards the North Pole; but of

those which stay to breed in any place, the number increases from the Equator up to the 60th degree of north latitude, where the forests begin to grow thin. But the progress of civilization has already had an influence on the migrations of certain species, by affording them an abundant supply of provisions, where they were before without any. Thus the starlings proceed further north as the culture of the Cerealia continues to extend in that direction, and the introduction of certain tubular flowers into the gardens of Florida, has enticed species of humming birds thither from the south. Some details were then given of the distribution of the various families of birds, and a table in the report exhibited the absolute number of species, as well as the number of such as breed in Philadelphia, Massachusetts, and Suskatchewan.*

ANATOMICAL AND PHYSIOLOGICAL REMARKS ON HUNCHBACKS.

ALTHOUGH the observations of Dr. Stern, recorded in Müller's Archiv, cannot be said to throw any new light upon this subject, yet they have served to place in nearer juxtaposition, and have elicited some curious points of comparison on the organization of this deformed class of persons. Even the most inattentive observer must have remarked the sort of family likeness, both of mind and body, that runs through the individuals labouring under this deformity; a likeness arising not merely from the existence of a hump in all, but from a similarity in complexion, in the general form of the head, and in the care-worn, superannuated appearance of the face. Their limbs, too, have all the same disproportioned appearance, and seem evidently fashioned to serve a trunk of larger proportions. But though the growth of other parts, as for example, the extremities, has not been suppressed equally with the growth of the trunk, yet neither has the developement of these parts proceeded regularly; and it is to this curious phenomenon that the memoir of Stern is directed, for he proves that the different bones of the extremities in hunchbacks do not bear their due proportion to each other. Thus, the thigh-bone is somewhat shorter than it ought to be, even in proportion to the diminished stature of the individual, while the bones of the feet are very large, and suited to a much taller person; of all the bones, the humerus is proportionally the longest, and to this is owing the great comparative length of the upper extremities in people thus deformed. The sculls of hunchbacks present a very curious proportion between the cranium, properly so called, or brain case, and the skeleton of the face. In fact, the former equals in size that of a well-grown adult, while the bones of the face remain undeveloped and small, as in childhood; thus giving their physiognomy a very curious expression, for in their heads old age and wisdom seem associated with several of the elements of childhood and simplicity. In the form of the lower jaw, in the great size of the mouth, and the compressed flatness of the lips,

* Jameson's Journal, No. 42.

in the sharp elongated nose, we recognise a striking likeness between all hunchbacks. It is curious thus to find that a disease of one or of a few vertebræ, occurring at an early period of life, serves not merely as a foundation for a permanent deformity in the spine itself, but proves that means of modifying the size and shape of even distant organs, such as the bones of the face and of the extremities; an occurrence of this sort taking place before our eyes, and long after birth, teaches us what we may expect from injuries or diseases of any important organ during the growth of the fœtus; prepares us for expecting that certain malformations of central organs necessarily give rise to secondary disturbances in the developement of some given parts lying more in the circumference. It would be extremely interesting to determine what influence the situation of the hump has in disturbing distant developement; is the general formation of the face and limbs, when the hump arises low in the back, different from that which distinguishes those whose humps occupy a situation higher up? It is curious enough, and contrasts strongly with the effects on the facial developement produced by a hump on the back, that some infants are born with the face fully formed, but wanting the brain and spinal marrow !*

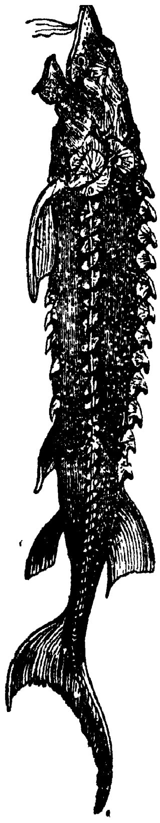
THE COLOMBIA RIVER STURGEON, (ACIPENSER TRANSMONTANUS, RICHARDSON.)

THE sturgeons resemble the sharks in their general form, but their bodies are defended by bony shields, disposed in longitudinal rows; and their head is also well cuirassed externally. Sturgeons ascend rivers in shoals, for the purpose of spawning. The migrations of some are confined entirely to fresh water; others pass a part of the year in the sea. They are particularly abundant in the seas and rivers of northern Asia, and are of great importance in an economical point of view, to the various nations under the Russian sway. Caviar is made from the roe, isinglass from the air-bladder, the flesh is eaten fresh, salted, or preserved by aromatic substances, and even the ligamento cartilaginous cord which pervades the spine, constitutes a Russian delicacy named *veirga.*

The sturgeons of North America, though almost equally numerous with those of Asia, are of comparatively little benefit to the natives. A few speared in the summer time, suffice for the temporary support of some Indian hordes; but none are preserved for winter use, and the roe and sounds are utterly wasted. The northern limit of the sturgeon in America is, probably, between the 55th and 56th parallels of latitude. Dr. Richardson has not met with any account of its existence to the northward of Stewart's Lake, on the west side of the Rocky Mountains; and, on

* Jameson's Journal, No. 42.

the east side, it does not go higher than the Saskatchewan and its tributaries. It is not found in Churchill River, nor in any of the branches of the Mackenzie or other streams that fall into the Arctic Sea—a remarkable circumstance, when we consider that some species swarm in the Asiatic rivers which flow into the Icy Sea. Sturgeons occur in all the great lakes communicating with the St. Lawrence, and also along the whole Atlantic coast of the United States down to Florida. Peculiar species inhabit the Mississippi: it is, therefore, probable that the range of the genus extends to the Gulf of Mexico.



The sturgeon fishery of Pine Island Lake, whose waters fall into the Saskatchewan, is most productive in the summer, a stray individual being very rarely taken at other seasons. The sturgeons make their first appearance when the river breaks up in the spring, and the lake is flooded with muddy water. The great rapid which forms the discharge of the Saskatchewan into Lake Winnipeg, appears quite alive with these fish in the month of June; and some families of the natives resort thither at that time, to spear them with a harpoon, or grapple them with a strong hook tied to a pole. Notwithstanding the great muscular power of the sturgeon, it is timid; and Dr. Richardson has seen one so frightened by the paddling of a canoe, that it ran its nose into the muddy bank, and was taken by a *voyageur*, who leaped upon its back. The Saskatchewan sturgeon weighs from ten to twenty pounds, and rarely attains the weight of sixty: June is the principal spawning time, but individuals filled with roe have been killed in every season of the year.

Two specimens of a sturgeon which Dr. Richardson has named *Acipenser Transmontanus*, were sent to him, during the late northern land expeditions, under Captain Sir John Franklin, by Dr. Gairdner, from Fort Vancouver, accompanied by the following notice:—"The small species attains eleven feet in length, and a weight of six hundred pounds. It enters the Colombia early in March every year, and is caught as high up as Fort Colville, notwithstanding the numerous intervening cataracts and rapids, which seem to be insuperable barriers to a fish

so sluggish in its movements. It disappears about the month of September. It is termed by the Chenooks *katlook*, and in the language of the Cascade Indians, *nakhun*."

The Colombia River sturgeon belongs either to the *Sturiones* or *Sterletæ*, two of the four groups into which Brandt has divided the genus, the approximation or remoteness of the shields by which these two forms are characterized, not being very precise as a practical mark of distinction. Its snout is broad, as in the common sturgeon, but much more depressed, and its mouth is comparatively large. The colours are—body and top of the head of a hue intermediate between yellowish and bluish grey, partially iridescent; shields ash-grey, giving a spotted appearance to the back; sides silvery white, with faint, vertical, bluish-grey bands; belly white.

Our acknowledgment for the original of the wood cut, and the above details, is due to Dr. Richardson's Northern Zoology.*

RESEARCHES ON THE STRUCTURE OF THE TEETH.

Extract of a Letter from M. Retzius to M. Flourens.

MESSRS. RETZIUS and Purkinje have been engaged, much about the same time, but unknown to each other, in microscopic researches on the teeth. The observations of the latter anatomist have been published in the Inaugural Theses of two of his pupils, viz., those of Messrs. Frankel and Raschow; and M. Retzius has published his in the last volume of the Memoirs of the Academy of Stockholm, which will speedily appear. M. Purkinje, says the author of the letter, has carried farther than I have done his researches upon the enamel; and I believe that I, on the other hand, have pushed my investigations further on the structure of the osseous portion. The two preparations which I transmit along with this letter, will enable you to verify the accuracy of my conclusions. Both M. Purkinje and myself have recognised that the osseous substance is principally composed of waving fibres, and of hollow cylindrical canals, which extend from the cavity of the pulp or lining membrane in a radiating manner towards the surface; I have observed that they are ramified with great regularity, and but rarely communicate with each other. Under the microscope they appear like vessels which are filled with a white substance. I may add that the same structure is witnessed in the teeth of all the vertebrata. Since these observations were published, I find that Leuwenhoeck had made similar ones, but they had entirely been lost sight of. The two preparations I send you are prepared from human teeth, and on both a groove may be found, the one running vertically, the other horizontally, and in the centre of the crown. We have

* Mirror, No. 792.

both discovered the cortical substance of Tenon, which surrounds the root of the human teeth. This substance, according to our observations, very much resembles in structure that of the bones; it has the same small cavities, and undulating canals, but it appears to have no blood-vessels, or cylindrical tubes, or radiated canals.*

MICROSCOPIC RESEARCHES ON THE STRUCTURE OF THE TEETH.

By M. F. Dujardin.

THE author having detailed the recent labours of Messrs. Purkinje and Retzius, (as stated above,) remarks that Malpighi had, as early as 1667, observed the structure of the enamel; and that Leuwenhoeck, in 1687, announced that the bony portion is composed of a union of small tubes, in which he could perceive infiltrations, the result of capillary attraction. M. Dujardin then points out his method of observation, which consists in removing, by means of the small chissel of the engraver, laminæ of extreme fineness, either parallel to the exterior surface, or in the direction of the natural fissures, or perpendicular to the axis. The laminæ thus procured without roughness, which, be it observed, is not a little difficult, are exposed under water, placed between two fine plates of polished glass, and introduced into the microscope, varying the mode of illumination, and augmenting the power of the light by means of lenses placed underneath. The parallel laminæ of the surface exhibit in all teeth of mammalia, holes or pores of from 1·1,100th to 1·1,500th part of a line in size, and spaces 1·500th of a line, so that there are from 380 to 500 in the length of a line. This is nearly the number indicated by Leuwenhoeck; but the observations of M. Purkinje differ, inasmuch as this observer has found intervals five or six times as great as the pores or tubes. These pores are sometimes round or oval, but they are irregular, and elongated, and even appear to arise from the unity of several pores. This irregularity alone is sufficient to indicate that they are not the orifices of tubes or vessels; and besides, it is impossible to recognise in the fine laminæ any difference of density, forming a concentric circle round the pores, which would have been the case if they were the sections of tubes or vessels; and moreover the rupture of these laminæ does not exhibit that they have proper parietes, which are more resisting. The pores, especially in the long teeth, such as the canine, assume a somewhat regular disposition in a longitudinal direction, and it is in this direction also that the fissures are most easily produced, because at each pore there is a corresponding elongated gap, or a small canal proceeding from the axis. If one of the laminæ is raised from the surface of these fissures, we see very distinctly the small canals,

* Jameson's Journal, No. 43.

which are all nearly parallel, with a diameter nearly equal, proceeding from the centre towards the surface; but the irregularity in their calibre, and their intercommunications with each other, also go to prove that they are gaps left in the bony substance at the time it is secreted by the dentary pulp, and not pre-existing tubes, which would assume a very different kind of uniformity. M. Dujardin, moreover, has not been able to perceive the regular ramifications attributed by M. Retzius to the canals, nor the waving fibres which this anatomist states to be distinct from the cylindrical hollow tubes. He concludes by pointing out the difference which the structure of the teeth of fishes exhibits from that of the mammalia. As an example, he takes that of the pike, and at once found that it split, as did the others, with most ease in the direction of its length, whilst, on the whole, it is much softer. Their centre is composed of a fibrous bundle, as Malpighi had previously announced, and here he found irregular shut lacunæ of a considerable size. The cortical part, which is about 1·15th of a line thick, separated from the central portion by a circle of compressed lacunæ, is composed of laminæ or fibres of a particular structure, bent outwards, and wholly different from the enamel or bony substance of other teeth.*

BIRTH EXTRAORDINARY.

An event interesting to physiologists occurred at half-past six on Sunday, the 2 rd of October. The wife of the dwarf, Don Santiago de los Santos, (herself a dwarf,) was delivered of a well-formed, male infant, at their residence, No. 167, High Holborn, near Museum-street. The accoucheurs were Mr. Bowden, of Sloane-street, Chelsea, who once before attended Donna Santiago on a similar occasion; and Dr. Davis, of Saville-row. Both gentlemen had for some time been very assiduous in their attentions to the little lady: but the infant, though it came into the world alive, did not survive its birth above an hour. Its length is thirteen inches and a half; its weight is one pound four ounces and a half, (avourdupois;) it is in every respect well formed; and the likeness of its face to that of the father is very striking. It was carried in a coffin to St. George's Church, Bloomsbury; but, being there refused sepulture, it was taken home, preserved in spirits, and was exhibited for some time, previously to being deposited in one of our public museums. Dr. Davis was very anxious to have it submitted to dissection, and to lecture upon it at the theatre of the Londen University; this, however, was declined by the Lilliputian parents, who appeared to feel poignantly this second disappointment of their hopes.†

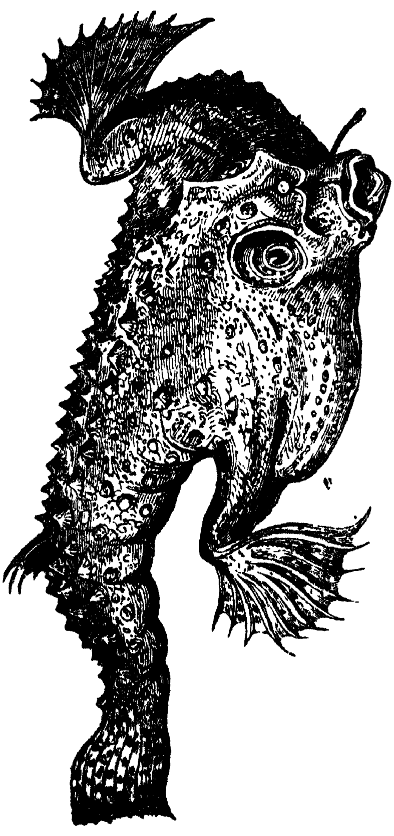
* Jameson's Journal, No. 43.

† Mirror, No. 803.

NEW FISH.

The cut represents one of the most extraordinary contributions to our knowledge of the zoology of the northern parts of British America; and is one of the objects of natural history collected on the late northern land expeditions under the command of Captain Sir John Franklin, R.N.

The monstrous-looking fish here figured is of the family of *Batrachoideæ*: genus, *Lophius*, Linnæus; and sub-genus, *Malthe*, Cuvier; or, as Dr. Richardson terms it, Lophius (Malthe) Cubifrons, *Square-browed Malthe.*



(The Square-browed Malthe.)

The sub-genus Malthe has the following characters assigned to it in the *Regne Animal*. The head much depressed and greatly widened by the jutting out of the elongated subopercula; the eyes far forward; the snout projecting like a small horn; the protractile mouth of a moderate size under the snout; the gill-membranes sustained by six or seven rays, and opening on the dorsal aspect by a hole above each pectoral fin.

Most of the fish of this family can live long out of water, in consequence of the smallness of their gill-openings: indeed, those of one of the genera are able, even in warm countries, to pass two or three days in creeping over the land. All the family conceal themselves in the mud or sand, and lie in wait to take their prey by surprise.*

* Of this family are the Toad-fishes.

Mr. Audubon very kindly presented to Dr. Richardson the above specimen of the Square-browed Malthe, which was taken on the Labrador coast; and appears to belong to a species hitherto undescribed. The doctor has received no account of its habits. Its intestines were filled with small crabs and univalve shells, none of which were crushed, as they pass entire, after their inhabitants have been digested.

The specimen has been so long immersed in rum, that its original colour cannot be determined. At present, its upper surface is greyish-white, with some brown blotches, as if of dirt, adhering to the grained skin. The caudal and pectoral fins are whitish, with small, round, brown spots. The under surface of the body is uniformly greyish-white. It has neither cæca nor air-bladder; the liver is large and oily. The extreme length of this fish, or from the frontal tubercle to the tip of the caudal fin, is 7 inches 11 lines.

For the remainder of the description, which is somewhat copious, the reader is referred to Dr. Richardson's valuable work.*

SOCRATES NOT POISONED BY HEMLOCK.

Dr. Christison, in his memoir on hemlock, in the Edinburgh Philosophical Transactions, states, that the poison which terminated the existence of Socrates was not our hemlock, or, at least, that the description given of the symptoms produced by the action of the poison do not correspond with those of the hemlock known to us. Plato says, "When he felt his limbs grow weary, he lay down on his back, for so the man had told him to do, and at the same time the person who administered the poison went up to him, and examined, for a little while, his feet and legs, and then squeezing his foot strongly, asked him whether he felt him do so. Socrates replied, that he did not. After this the man did the same to his legs, and proceeding upwards in this way, showed that he was cold and stiff. As he approached him he said to us, that when the effects of the poison would reach the heart, Socrates would depart; and now the parts about the lower belly were cold, when he uncovered himself (for he was covered up), and said, (which were his last words,) Crito, we owe Esculapius a cock, pay the debt, and do not forget it. It shall be done (replied Crito), but consider whether you have any thing else to say. Socrates answered not, but in a short time was convulsed." The following were the phenomena observed when *conein*, or the essence of hemlock, was administered:—"Six drops were allowed to fall into the back of the throat of a young active puppy ten weeks old. In thirty seconds there was sudden convulsive respiration, and some stiffness of the hind legs, immediately followed by great feebleness of those legs. In a few seconds the

* Mirror, No. 786.

fore legs became also very feeble. In sixty seconds from the time the poison was introduced the breathing ceased. Slight convulsive tremours followed for a single minute more." The author concludes that the ancient poison is still unknown to us.*

THE ERMINE WEASEL.—(MUSTELA ERMINEA, LINN.)

by a Correspondent of the Analyst, No. 18.

THE following facts may not be unworthy of record, inasmuch as they tend to illustrate the peculiar habits of an animal which is commonly doomed to the most unrelenting destruction, although possessed of some redeeming qualities, the promulgation of which might, perhaps, entitle it to our protection.*

During one of the severe winters with which we were visited some years ago, my attention was attracted towards certain patches of rough pasture, lately disclosed by the melting of the snow, beneath which they had long been concealed. I saw something approaching them, which had it not been for its lively motions, I should scarcely have distinguished from the white scenery around. On drawing nearer, I discovered it to be an Ermine Weasel (*Mustela erminea*, Linn.), which had adopted its winter clothing. It was evidently in pursuit of prey, and the curiosity I felt to discover the object of its search, made me more cautious not to disturb its occupation. After losing sight of it a short time, I saw it emerging from a tuft of grass with a Field Mouse (*Mus sylvaticus*) in its mouth, and directing its course to a contiguous plantation. When arrived there, it quickly ascended a young Fir tree with its burden and then as expeditiously descended without it. I continued to watch the motions of the little animal amongst the dead leaves, which lay in heaps around, until an opportunity of catching it unawares, whilst the head and foreparts were concealed amongst the leaves, presented itself, of which I did not fail to avail myself. In vain did my little captive bite and struggle; a strong pair of gloves and a firm grasp, effectually baffled all its attempts at escape; and after striking my victim several sharp blows on the head, I was fully persuaded that I had accomplished my purpose of putting an end to its existence. Whilst I continued to carry it in my hand, it had all the appearance of being quite dead, but no sooner had it touched the ground, upon which I soon after threw it, than the hypocritical little creature at once found its liveliness and strength restored, and immediately ran off with the greatest agility. After I had recovered my surprise, I felt an anxiety to know what had become of the mouse with which the weasel had ascended the fir-tree. On climbing up it (the tree was at least fifteen feet high) I observed a small bird's nest towards the top, in which the Mouse had been safely deposited by its destroyer.

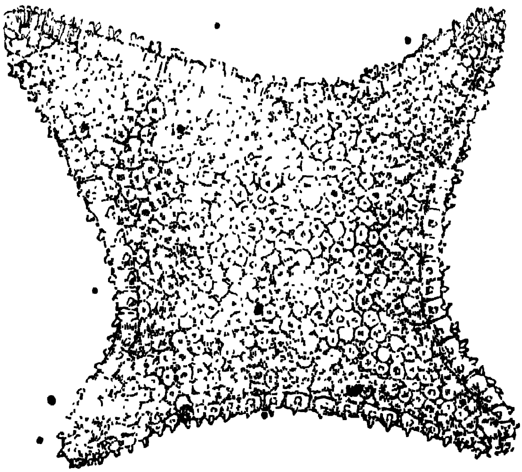
* Jameson's Journal, No. 42.

Upon another occasion I perceived an Ermine Weasel in such close pursuit of a Rat that I had time to get my gun, and at one shot killed them both.

Surely this species is capable of being tamed, and made practically useful to mankind; its propensities are the same as those of the Ferret Weasel *(Mustela furo)*, and in its nature it is much more hardy and less liable to disease.

ASTERIAS JOHNSTONI.

DR. GEORGE JOHNSTON, of Berwick-upon-Tweed, has procured this beautiful and rare species from the Coast of Caithness Mr. J. E. Gray, who has examined the specimen figured, tells him that it is quite distinct from the true Astèrias equéstris; and he has, in consequence, assigned to it the specific name which is here adopted. Dr. J. is, nevertheless, convinced that the species is identical with the A. equéstris of British authors; and, if this is a correct opinion, then the discovery of it, as a native animal,



(Asterias Johnstoni.)

is due to the late Mr. Brodie of Brodie, who found it in the Murray Frith, and sent a specimen to Sowerby, in whose British Miscellany it is figured. Dr. Patrick Neill subsequently met with this star-fish in the Frith of Forth; as yet the most southern locality: though Dr. J. doubts not, now that our naturalists are alive and active in their pursuits, it may, ere long, be added to the English fauna.

Description.—Body square; sinuated between the angles, of which two are somewhat more produced than the others; flat, rough with papillary warts and miliary granules, the latter encircling the dilated smooth base of the obtuse papillæ; these granules and warts cover the surface, but in the centre of a ring of granules there are frequent small apertures protected by a pair of roundish scales, which open and shut at the will of the animal: operculum lateral, slightly convex, deeply grooved, the grooves branched; margin obtuse, thick, protected with a double series of large square plates studded with from two to four papillæ, and each of them surrounded with a series of granules: the ventral surface is divided into four triangular spaces by the tentacular avenues, which are fringed on each side with a double series of smooth, blunt, short, and slightly compressed processes, or spines: the triangular spaces are very rough, with enlarged granules and valvular openings, but there are no dilated bases for papillæ, and the valvular apertures are arranged in rows; in the centre of each of the compartments there is a large irregular opening. When fresh, the colour is a bright red or scarlet; but, on keeping, the colour fades to a faint and dirty brownish yellow. The figure represents it about one half the natural size.*

ZOOLOGICAL SOCIETY.

Notes, selected and abridged from the Proceedings of the Committee of Science and Correspondence.

TURNIP INSECT.

November 24, 1835, Mr. Yarrell read some "Notes on the Economy of an Insect destructive to Turnips;" which he prefaced by adverting to the importance to agriculture of an attentive collection of those entomological facts which relate to species injurious to the ordinary crops of the farmer. He then proceeded to remark that the turnip crop is in this country usually infested in every season by two species of *Haltica;* and that another destroyer has been, in the dry summer of this year, superadded to them, especially on the light and chalky soils. To the history of this latter pest, which has been known to occur in those seasons only in which there has been an almost total absence of rain, Mr. Yarrell's paper is directed. A good account of a similar visitation in 1782, as it was observed in Norfolk by Mr. William Marshall, was published in the "Philosophical Transactions" for the following year. Early in July last the "yellow fly" was seen upon the young turnips. It was remembered by some farmers that this was the fly which prevailed in the year 1818, and which was followed by the caterpillars known by the name of the blacks. The eggs being deposited by the perfect insect in the leaf of the plant, the black caterpillar or turnip-pest speedily makes its appearance, feeding on the soft portions of the leaves of the turnips and leaving the fibres untouched; and finally, casting its black skin and assuming one of a more slaty or grey colour, it buries itself in the earth. Lodged there, it forms for itself, from the soil, a strong oval cocoon; from which some of the earlier broods pass almost immediately into the perfect state, filled with *ova*, and ready quickly to supply another generation of destroyers. So complete and so rapid was the destruction in some instances, that a whole field was found, in two or three days, to present only an assemblage of

* Magazine of Natural History, No. 59.

skeletonized leaves; and this too when the turnips had attained a considerable size.

The insect whose proceedings have been thus briefly noticed, belongs to the *Hymenopterous* family *Tenthredinidæ*; it is the *Athalia Centifoliæ*, a species first noticed by Panzer. Mr. Yarrell describes the perfect insect and the caterpillar; and then recurs to the damage effected by the latter. By their repeated broods the devastation was continued for so long a time that even the third sowing did not in all cases escape destruction; and it was not until the occurrence of the heavy rains in September, terminating the unusually dry summer, that the mischief ceased. The destruction of the leaves caused, in most instances, the loss of the root also; and where the leaves suffered from the attacks of the black caterpillar, but not sufficiently to occasion the death of the plant, the turnip itself became pithy and of little value. It has become necessary, Mr. Yarrell states, to import the root largely from the Continent to supply the deficiency of the home crop.

The remedial measures adopted on a former visitation were the turning into the infested fields of a large number of ducks, who greedily devoured the caterpillars as they were brushed from the leaves by a boy with a long pole: the passing of a heavy roller over the ground at night, when the caterpillars were at their feed; and the strewing of quick lime by broad cast over the fields, renewing it as often as it was dispersed by the wind. The latter mode was generally considered as the most effectual preservative.

BREEDING CURASSOWS.

January 12, 1836.—A note addressed to the Secretary by Sir Robert Heron, Bart. M.P., was read. It referred to the writer's success in the breeding of Curassows in the last summer at Stubton.

From two individuals in his possession, the male of which is entirely black, and the female of the mottled reddish brown colour which is regarded as characteristic of the *Crax rubra*, Linn., Sir R. Heron has hatched in the last year six young ones in three broods of two eggs each: the eggs were placed under turkeys and common hens. Respecting one of them no notes were made; but the other five were all of the red colour of the female parent. Two of these, which were at two or three weeks old very strong, being still in the flower-garden, were killed in the night by a rat that had eaten its way into the coop in which they were. Two others were sent to the Earl of Derby, who wanted hens. The remaining one is now nearly, if not quite, full grown; and Sir R. Heron proposes to place it with the old pair.

"There is one great peculiarity," Sir R. Heron remarks, "attending the old pair. Their principal food is Indian corn and greens, both which they eat in common: but whenever any biscuit is given to them, as an occasional treat when visiters are here, the male breaks it and takes it in his mouth; waiting, however long, until the hen takes it out of his bill; which she does without the slightest mark of civility, although on excellent terms with him. This proceeding is invariable."

GIRAFFES.

February 9.—A letter was read, addressed to the Secretary by M. Thibaut, and dated Malta, January 8, 1836. It communicated various particulars relative to the Giraffes belonging to the Society, which have recently been obtained by the writer and which were then in his custody, and may be translated as follows:—

"Having learnt, on my arrival at Malta, that you were desirous of information on the subject of the four Giraffes which the Society has entrusted to my care, I regard it as a duty to transmit to you a short statement, by which you will become aware of the difficulties that I encountered in obtaining and preserving for the Society these interesting animals, which are now, I hope, out of danger.

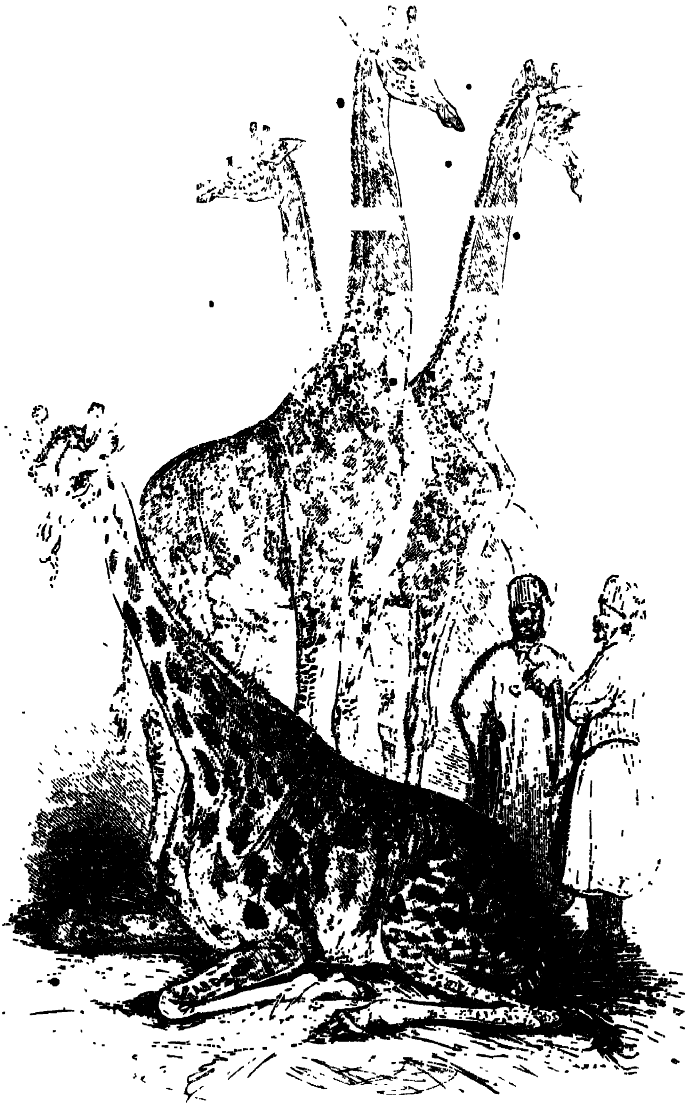
"Instructed by Colonel Campbell, His Majesty's Consul General in the Levant, and desirous of rendering available for the purposes of the Zoological Society the knowledge which I had acquired by twelve years' experience in travelling in the interior of Africa, I quitted Cairo on the 15th of April, 1834. After sailing up the Nile as far as Wadi Halfa (the second cataract), I took camels, and proceeded to Debbat, a province of Dongolah; whence, on the 14th of July, I started for the desert of Kordofan.

"Being perfectly acquainted with the locality, and on friendly terms with the Arabs of the country, I attached them to me still more by the desire of profit. All were desirous of accompanying me in my pursuit of the Giraffes, which, up to that time, they had hunted solely for the sake of the flesh, which they eat, and of the skin, from which they make bucklers and sandals. I availed myself of the emulation which prevailed among the Arabs, and as the season was far advanced and favourable, I proceeded immediately to the south-west of Kordofan.

"It was on the 15th of August that I saw the first two Giraffes. A rapid chase, on horses accustomed to the fatigues of the desert, put us in possession, at the end of three hours, of the largest of the two; the mother of one of those now in my charge. Unable to take her alive, the Arabs killed her with blows of the sabre, and, cutting her to pieces, carried the meat to the head-quarters which we had established in a wooded situation; an arrangement necessary for our own comforts and to secure pasturage for the camels of both sexes which we had brought with us in aid of the object of our chase. We deferred until the morrow the pursuit of the young Giraffe, which my companions assured me they would have no difficulty in again discovering. The Arabs are very fond of the flesh of this animal. I partook of their repast. The live embers were quickly covered with slices of the meet, which I found to be excellent eating.

"On the following day, the 16th of August, the Arabs started at daybreak in search of the young one, of which we had lost sight not far from our camp. The sandy nature of the soil of the desert is well adapted to afford indications to a hunter, and in a very short time we were on the track of the animal which was the object of our pursuit. We followed the traces with rapidity and in silence, cautious to avoid alarming the creature while it was yet at a distance from us. Unwearied myself, and anxious to act in the same manner as the Arabs, I followed them impatiently, and at 9 o'clock in the morning I had the happiness to find myself in possession of the Giraffe. A premium was given to the hunter whose horse had first come up with the animal, and this reward was the more merited as the laborious chase is pursued in the midst of brambles and of thorny trees.

"Possessed of this Giraffe, it was necessary to rest for three or four days, in order to render it sufficiently tame. During this period an Arab constantly holds it at the end of a long cord. By degrees it becomes accustomed to the presence of man, and takes a little nourishment. To furnish milk for it I had brought with me female camels. It became



(The Giraffes in the Menagerie of the Zoological Society, Regent's Park.)

gradually reconciled to its condition, and was soon willing to follow, in short stages, the route of our caravan.

"This first Giraffe, captured at four days' journey to the south-west of Kordofan, will enable us to form some judgement as to its probable age at present; as I have observed its growth and its mode of life. When it first came into my hands, it was necessary to insert a finger into its mouth in order to deceive it into a belief that the nipple of its dam was there: then it sucked freely. According to the opinion of the Arabs, and to the length of time that I have had it, this first Giraffe cannot, at the utmost, be more than nineteen months old. Since I have had it, its size has fully doubled.

"The first run of the Giraffe is exceedingly rapid. The swiftest horse if unaccustomed to the desert, could not come up with it unless with extreme difficulty. The Arabs accustom their coursers to hunger and to fatigue; milk generally serves them for food, and gives them power to continue their exertions during a very long run. If the Giraffe reaches a mountain, it passes the heights with rapidity: its feet, which are like those of a Goat, endow it with the dexterity of that animal; it bounds over ravines with incredible power; horses cannot, in such situations, compete with it.

"The Giraffe is fond of a wooded country. The leaves of trees are its principle food. Its conformation allows of its reaching their tops. The one of which I have previously spoken as having been killed by the Arabs measured 21 French feet in height from the ears to the hoofs. Green herbs are also very agreeable to this animal; but its structure does not admit of its feeding on them in the same manner as our domestic animals, such as the Ox and the Horse. It is obliged to straddle widely; its two fore-feet are gradually stretched widely apart from each other, and its neck being then bent into a semicircular form, the animal is thus enabled to collect the grass. But on the instant that any noise interrupts its repast, the animal raises itself with rapidity, and has recourse to immediate flight.

"The Giraffe eats with great delicacy, and takes its food leaf by leaf, collecting them from the trees by means of its long tongue. It rejects the thorns, and in this respect differs from the Camel. As the grass on which it is now fed is cut for it, it takes the upper part only, and chews it until it perceives that the stem is too coarse for it. Great care is required for its preservation, and especially great cleanliness.

"It is extremely fond of society and is very sensible. I have observed one of them shed tears when it no longer saw its companions or the persons who were in the habit of attending to it.

"I was so fortunate as to collect five individuals at Kordofan; but the cold weather of December, 1834, killed four of them in the desert on the route to Dongolah, my point of departure for Bebbah. Only one was preserved; this was the first specimen that I obtained, and the one of which I have already spoken. After twenty-two days in the desert, I reached Dongolah on the 6th of January, 1835.

"Unwilling to return to Cairo without being really useful to the Society, and being actually at Dongolah, I determined on resuming the pursuit of Giraffes. I remained for three months in the desert, crossing it in all directions. Arabs in whom I could confide accompanied me, and our course was through districts destitute of every thing. We had to dread the Arabs of Darfour, of which country I saw the first mountain. We were successful in our researches. I obtained three Giraffes, smaller

than the one I already possessed. Experience suggested to me the means of preserving them.

"Another trial was reserved for me: that of transporting the animals, by bark, from Wadi Halfa to Cario, Alexandria, and Malta. Providence has enabled me to surmount all difficulties. The most that they suffered was at sea, during their passage, which lasted twenty-four days, with the weather very tempestuous.

"I arrived at Malta on the 21st of November. We were there detained in quarantine for twenty-five days, after which, through the kind care of Mr. Bourchier, these valuable animals were placed in a good situation, where nothing is wanting for their comfort. With the view of preparing them for the temperature of the country to which they will eventually be removed, I have not thought it advisable that they should be clothed. During the last week the cold has been much greater than they have hitherto experienced; but they have, thanks to the kindness of Mr. Bourchier, every thing that can be desired.

"These four Giraffes, three males and one female, are so interesting and so beautiful, that I shall exert myself to the utmost to be of use to them. It is possible that they may breed; already I observe in them some tendency towards mutual attachment. They are capable of walking for six hours a day without the slightest fatigue."

INDIAN ANTELOPE.

March 22.—Mr. Bennett directed the attention of the meeting to an interesting species of the Indian Antelope, *Antelope Cervicapra*, Pall., now at the Society's gardens. It consists of four individuals: an adult and aged male, brought by Col. Sykes from Bombay, and presented by him to the Society nearly five years ago; a younger, yet adult, male, which was presented, in an immature condition, about two years since; an immature male, lately arrived in the menagerie, and in about the same state of developement as that in which the last-mentioned individual was when it was originally presented; and an emasculated individual of full growth. In the older of these antelopes, the rich deep colour of the body generally is so intense as almost to approach to black, and the horns are strong and fully developed: the possession of horns and the depth of colouring, which are peculiar to the male sex, are exhibited in it at their maximum. The second individual approximates nearly to it in the degree in which these secondary sexual characters are developed. In the third, the youngest of the series, there exist the horns characteristic of the male, but these organs are yet of small growth, are only beginning to be annulated at their base, and are commencing their first spiral turn; its colour, as is very generally the case among the young of animals that in adult age are differently coloured in the sexes, is that of the female, which in this instance is a dull fawn with a pale stripe along the side: it has, consequently, in these two striking particulars, full evidence of immaturity. The emasculated individual was probably, at the period when that accident or operation occurred which prevented the developement of its sexual characters, at nearly the same age as the one last adverted to: it has since continued to increase in bulk, and it even exceeds in size, as often happens in castrated animals, the perfect adult male of the same species: but the secondary sexual characters of the male have not been developed in it: it retains the dull fawn colour of immaturity, and its horns have not acquired the strength, the annulation, or the spiral turns which belong to those of the adult and perfect

male. One of the horns has been broken off; perhaps the more readily from some weakness in its structure, consequent on its unimportance to an animal so degenerated: the other retains, at a short distance from its normally formed tip, a few rings, but beyond these the surface has become smooth, the substance remains weak and comparatively small, and the direction, instead of being in a succession of spiral turns, is in a single sweep, passing backwards above the base of the ear and then descending along the curve of the neck: it has, though weaker, much of the character of the horns of the African race of sheep. The general appearance of the animal is also sheep-like and tame.

Mr. Bennett proceeded to remark that these animals, although curious and interesting on account of the variations exhibited by them, in accordance with their several conditions, in those acknowledged secondary sexual characters, colour and horns, were yet more interesting when considered with reference to the state of another organ, the use of which has long remained a problem to zoologists, but which, it appeared to him, must be referred to sexual relations; he alluded now to the lacrymal sinus. Referring to its structure as to that of a sac, opening externally by a lengthened slit, but perfectly closed within, he remarked that that organ could not possibly be in any degree connected with the functions of respiration, there being no aperture through it for the passage of air. Its inner surface is covered by a smooth skin, with a few scattered and very short bristles, and is defended by a dark-coloured and copious secretion of ceruminous matter, which has a slight urinous or sexual odour. He did not feel himself competent, he stated, to explain the precise manner in which this organ is available for sexual purposes; yet he felt convinced that such is its use, from the consideration of its relative developement in the several Indian antelopes in the Society's menagerie.

In the more aged of these individuals, as indeed in the adult Indian antelope generally, the large cutaneous follicle beneath the eye known as the lacrymal sinus, is so prominent as to form a most striking feature in the animal's physiognomy: it never appears as a simple slit, its thickened edges pouting so widely as to be at all times partially everted. When the animal is excited, and it is constantly highly excitable, the eversion of the bag becomes complete, and its thick lips being thrown widely back, the intervening space is actually forced forwards so as to form a projection instead of a hollow: the animal is, on such occasions, delighted to thrust repeatedly the naked lining of the sac against any substance that is offered to him, which soon becomes loaded with the odour that has been referred to as belonging to the secretion. In the second individual, although it is perfectly mature, the protrusion of the inner surface of the sac is not quite to so great an extent as in the more aged male; and the less thickened edges of the sinus allow of a nearer approximation to its closure in the unexcited state of the animal. The youngest male has the lips of the sinus small and closely applied to each other, so as to hide completely the whole of the internal lining of the sac, and to exhibit, externally, a mere fissure: in it the lips are but slightly moved when the animal is interested. The emasculated individual, notwithstanding its full growth, has its suborbital sinus nearly in the same condition as that of the immature male: it is merely a slight fissure, the edges of which are closely applied to each other; and in it those edges do not appear to be at all moved, the animal being generally careless and inanimate. It would, consequently, seem that the same

cause which induced the retention, by this individual, of its immature colours, and which arrested the perfect growth of its horns, was adequate also for the checking of the developement of the suborbital sinuses. Those organs, therefore, would appear to be dependent on sexual perfection; and, consequently, to be, in some manner yet to be ascertained, subservient to sexual purposes, with the capacity for which they are evidently, in the phases of their developement, essentially connected.

Mr. Owen, who had conceived it possible that the secretion of these glands, when rubbed upon projecting bodies, might serve to direct individuals of the same species to each other, remarked that he had endeavoured to test the probability of this supposition by preparing a tabular view of the relations between the habits and habitats of the several species of antelopes, and their suborbital, maxillary, post-auditory, and inguinal glands; in order to be able to compare the presence and degrees of developement of these glands with the gregarious and other habits of the antelope tribe. He stated, however, that it was evident from this table, that there is no relation between the gregarious habits of the antelopes which frequent the plains, and the presence of the suborbital and maxillary sinuses; since these, besides being altogether wanting in some of the gregarious species, are present in many of the solitary frequenters of rocky, mountainous districts. The supposition, therefore, that the secretion may serve, when left on shrubs or stones, to direct a straggler to the general herd, falls to the ground.

Mr. Ogilby remarked, with reference to this subject, that he had had opportunities of observing, at the Surrey Zoological Gardens, a female of the Indian antelope, in which, when he first saw her, the lacrymal sinus was in a state of quiescence: but when he observed her again, a month afterwards, and probably in improved condition, that organ was in a state as excitable as it is in the old male of the Society's gardens.

He added, as a general remark, which, however, he stated was not universal, that in intertropical animals the lacrymal sinus is larger than in more northern species, and in those whose range is limited to mountainous districts.

He also described the lacrymal sinus of a species of Gazelle, which he had observed after death: it consisted of a gland furnished with six excretory ducts placed nearly in a circle, and with one central duct: from the orifices of these ducts, when squeezed, there issued out strings of a dense ceruminous matter.

Mr. Bennett stated, in conclusion, that since making his observations on the Indian antelope, which had led him to form the opinion he had advanced with respect to the use of the lacrymal sinus, he had received from Mr. Hodgson, of Nepal, a corresponding member of the society, a letter in which, among other subjects, some remarks are made on this organ as it exists in the Thar Antelope, and in the *Cervus Aristotelis*: in the former of those animals, Mr. Hodgson's observations prove that during the breeding season the lacrymal sinus is in a high state of activity. Mr. Hodgson's letter, which is dated Nepal, June 18, 1835, refers also to other glands in some other antelopes, as will be seen by the following extract.

"The *Chiru Antelope* has exceedingly large inguinal sacs, which hang by a long narrow neck from the loins. The longitudinal quasi maxillary gland of the *Cambin Otan* I doubt the existence of, and believe its 'suborbital sinus' to be similar to that of the *Thar*.

"The latter differs essentially from that organ in any deer or antelope I have seen; being furnished with a huge gland, filling the whole cavity or depression on the scull, and leaving the cuticular fold void of hollowness: it is filled up, like the bony depression, by the gland; whereas the gland of this sinus, in most deer and antelopes, is a tiny thing, and a dubious one. As to any *Cervine* or *Antilopine* animal breathing through the suborbital sinus, it cannot be, unless they can breathe through bone and skin! If you pass a fine probe down the lacrymal duct, you see the probe through the bottom of the osseous depression holding the cuticular fold called the suborbital sinus. But, however thin the plate of bone at the bottom of the former, it is there, without breach of continuity; and the cuticular portion of the apparatus has a continuous course throughout, leaving no access to the inside of the head. I am watching closely a live specimen of *Cervus Aristotelis*, to discover, if I can, the use of this organ. In a recently killed male of this species, I passed a pipe into the nose, up to the site of the suborbital sinus, and tried, in vain, for half an hour, with the aid of a dozen men's lungs, to inflate the sinus. Not a particle of air would pass; nor could I cause the sinus to unfold itself, as the live animal unfolds it, by means of a set of muscles disposed crosswise round the rim of it. In dissecting the sinus, I found only a feeble trace of a gland; so also, in the *Muntjac*.

"But in the Thar, the gland is conspicuous, being a huge lump of flesh, bigger than, and like in shape to, the yolk of an egg. The live Thar, too, in the spring especially, pours out a continuous stream of thin viscid matter from the sinus; not so in any deer. The Thar's gland seems to me connected with the generative organs: and I take its profuse secretion to be a means of relieving the animal (when it has no mate particularly) from the extraordinary excitement to which it is liable in the courting season. I have witnessed that excitement, and have been amazed at its fearful extent, topical and general, for six weeks and more.

"The Chiru's labial sacs, or intermaxillary pouches, are, most clearly, accessory nostrils, designed to assist breathing at speed. They spread with the dilatation of the true nostril, and contract with its contraction. This species has but five molar teeth on each side of either jaw."

BRUSH-TAILED KANGAROO.

April 12.—Mr. Bennett directed the attention of the Meeting to a living specimen of the Brush-tailed Kangaroo, *Macropus penicillatus*, Gray, which had recently been added to the Menagerie; having been presented to the Society by Captain Deloitte, Corr. Memb. Z. S. He remarked particularly on the peculiarity of its actions, as compared with those of the typical Kangaroos; and especially on the ease with which it vaults from the ground to any slight ledge, on which it remains perched, as it were, with its tail extended behind it: the tail, in fact, appearing to be in no respect aiding in the progression of the animal.

BRITISH FISHES.

April 12.—Specimens were exhibited of numerous species of British Fishes, forming part of the collection of Mr. Yarrell. They consisted of dried preparations of rather more than one half of the skin of each individual: a mode of preservation peculiarly adapted, as Mr. Yarrell remarked, for travellers over land; specimens so prepared occupying but little space, and being consequently as portable as dried plants. An in-

cision is made in the first instance round one side of the fish, at a short distance from the dorsal and anal fins, and the whole of the *viscera* and flesh are removed, so as to leave only the skin of the other side with the vertical fins attached to it, and with rather more than one half of the head; the loose edge of skin left from the side in which the incision has been made, is then fastened by means of pins to a piece of board, so as to display the entire side of the fish which it is intended to preserve, and it is then hung up to dry in an airy but shady situation. The more rapidly the drying is completed, the more effectually will the colours be preserved. As soon as the skin is dried it is varnished; and the loose edge of the skin on that side from whence the operation of removing the flesh has been effected is trimmed off with a pair of scissors, as being no longer useful. The preparation is then completed, and consists of the entire skin of one side of the fish, of the vertical fins, and of rather more than one half of the head, the latter being important for the preservation of the *vomer*, so as to show the absence or presence of teeth on that bone, and their form. All the essential characters of the fish are consequently preserved, if care be taken that the skin be so attached to the board on which it is dried, as to retain its original dimensions of length and depth: the due thickness of the fish may be secured in the preparation, if it be considered desirable, by inserting beneath the skin, when extending it on the board, a sufficient quantity of prepared horse-hair.

After explaining the mode which he had adopted in the preparation of the specimens exhibited, Mr. Yarrell made various remarks on those which he regarded as the most interesting among them; and particularly on a series of *Trout* and *Charr* from different localities, and varying in colour according to situation, to season, and also, in some instances, to food.

He then directed the attention of the Meeting to the specimens of the British species of Rays which formed part of the collection, and pointed out particularly the difference, as regards surface, which obtains in the sexes of many of these fishes; the skin of the female being, in every instance, comparatively smooth. He added also, by reference to these specimens, and to specimens of the jaws exhibited for that purpose, an explanation of the differences which exist, in adult individuals, in the teeth of the sexes respectively: those of the male becoming exceedingly lengthened and pointed, while in the female they retain very nearly their original flattened surface; the form of the teeth, equally with the armature of the surface, constituting in these fishes a secondary sexual character, although both the one and the other have repeatedly, but erroneously, been considered as adapted for the establishing of specific distinctions.

CYNICTIS MELANURUS.

May 24.—The skin was exhibited of a species of *Cynictis*, Og., which had recently been presented to the Society by Captain P. L. Strachan, by whom it was obtained at Sierra Leone. The exhibition was accompanied by a description of the animal by Mr. Martin, which was read.

Mr. Martin regards the animal as especially interesting on account of its presenting the second instance of the new form among the *Viverridæ* which was described by Mr. Ogilby at the meeting of the Society on April 9, 1833, under the generic appellation of *Cynictis*, and of which a detailed description and figure has since been published in the Transactions, vol. i. p. 29. It agrees with that genus, which is intermediate be-

tween *Herpestes* and *Ryzæna* in its general form; in the number of the toes with which its feet are furnished; and in the number and form of its teeth, as far as they are preserved in the specimen exhibited, which, however, is that of a young individual. The points of the teeth are consequently in it unworn and acute; while in the specimen of *Cyn. Steedmanni* described by Mr. Ogilby, which was evidently an aged individual, the teeth were much worn down. The only other differences which exist between the teeth of the new species and those of *Cyn. Steedmanni* consist in the presence, in the outermost incisor in the upper jaw of the former, of a minute but decided internal tubercle, which is not found in the corresponding tooth of *Cyn. Steedmanni*; and in the inner lobe of the carnassier of the upper jaw being acute and conical, instead of blunt: the teeth behind this, in both jaws, are wanting in the specimen of the new species. The feet of the new species differ from those of *Cyn. Steedmanni* by their comparatively shorter claws; and by having a naked line extending along the under surface of the *tarsus* from the pad to the heel, the whole of the under surface of the *tarsus* being covered in *Cyn. Steedmanni* with hair.

The new species may be thus characterized:—

Cynictis Melanurus. Cyn. saturatè rufus nigro punctulatus, ad latera pallidior; gulâ sordidè flavescenti-brunneâ; artubus internè abdomineque sordidè flavescenti-rufis; caudâ apicem versus latè nigrâ, ad apicem floccosâ.

Long. *corporis* cum capite, 12 unc.; *caudæ*, pilis inclusis, 11; *capitis*, 2 unc. 1 lin.

In addition to the distinctive characters which have been noticed above, it may be remarked that *Cyn. melanurus* differs from *Cyn. Steedmanni* in the greater smoothness, shortness, and glossiness of the fur; in the less bushy character of the tail; in the dark tint of the head, back and limbs; in the dusky colour of the throat; and in the black tip of the tail, the corresponding portion of this organ in *Cyn. Steedmanni* being white.

Mr. Ogilby remarked, that the animal described by Mr. Martin might probably be identical with the one noticed by Bosman under the name of *Kokeboe;* but added, that the notice given of it by that traveller was not sufficiently precise to admit of its being determined with certainty.

THE YAPOCK.

A specimen was exhibited of the *Chironectes Yapock*, Desm., on which Mr. Ogilby remarked as follows:—

"I am indebted to Mr Natterer for the opportunity of examining this rare and curious animal, of which he brought various specimens from Brazil. That now exhibited is a male, and possesses the same anomaly in the generative organs which characterizes the rest of the *Marsupials*. I have not seen the female, but Mr. Natterer informs me that the abdominal pouch is complete. The species is found in all the smaller streams of Brazil, and appears to extend from the southern confines of that empire, to the shores of the Gulf of Honduras; Buffon's specimen came from Cayenne, and a skin was recently obtained by Mr. W. Brown Scott, labelled, '*Demerara Otter*.' Both this and Mr Natterer's specimen agree with the figure and description of Buffon, except that they are of a larger size, and instead of a grey mark over each eye, have a complete band of that colour extending entirely across the forehead. In Mr. Natterer's specimen the terminal half-inch of the tail only is

white; in Mr. Scott's, on the contrary, the last four inches are of this colour: the tail is exactly of the same length as the body; it measured ten inches in the former specimen and twelve in the latter, but Mr. Natterer informs me that he has other specimens which measure fourteen or fifteen inches in length.

"The teeth of this animal are altogether different from those of the *Opossums* (*Didelphis*); and I am at a loss to reconcile my own observations with those of M. F. Cuvier upon this subject, as given in 'Les Dents des Mammiferes,' p. 73, unless by supposing that there must have been some mistake about the skull referred by M. Cuvier to the *Yapock*. For my own part, I could not be deceived in this matter, as the skull which I examined had never been extracted from the specimen. The incisors and canines are of the same form and number as in the true *Opossums*, the two middle incisors above being rather longer than the lateral, those below broader and a little separated. The molars are five on each side, two false and three real, both in the upper and under jaws. The first false molar is rather small and in contact with the canine, both above and below: the second is half as large again, and both are of a triangular form, with apparently two roots. The three real molars are of the normal form of these teeth among the *Opossums*. The first of the upper jaw is longer than it is broad, and has four sharp elevated tubercles with a low heel projecting backwards; the second resembles it in general form, but is larger and broader; the third is small and resembles the tuberculous molars of the true *Carnivora*. In the lower jaw the three real molars do not materially differ in point of size. They are narrower than those of the upper, have their tubercles arranged in a single longitudinal series, a single large one in the centre, and a smaller on each side.

"The *Yapock* has very large cheek-pouches which extend far back into the mouth, and of which the opening is very apparent. This circumstance, hitherto unobserved by zoologists, throws considerable light upon the habits of this rare animal, which thus appears, like the *Ornithorhyncus*, to feed upon fresh water *Crustacea*, and the larvæ of insects, spawn of fishes, &c., which it probably stows away in its capacious cheek-pouches. For two inches at the root the tail is covered with the same description of fine close fur as the body; from this part it tapers gradually to the point and is covered with small scales, arranged in regular spiral rows, and interspersed with bristly hairs, particularly on the under surface, a fact perfectly conclusive against the generally received opinion of this organ being prehensile in the *Chironectes*. Indeed, the tail so perfectly resembles that of the *Hydromys chrysogaster*, even to the white tip, that it would be impossible to distinguish these organs if separated from the respective animals. The useless appendage of a prehensile tail to an aquatic animal, must consequently be henceforth discarded for the history of the *Chironectes*, and the animal allowed to take its place among conterminous genera, not as a compound of anomalous and contradictory characters, but as a regular component link in the scale of existence. That its habits are purely aquatic, and that it has not the power of ascending trees, is further proved by the structure of the extremities. The hind feet are broad like those of the *Beaver*; the toes, including the thumb, united by a membrane, and, with the exception of the thumb, provided with small falcular claws; the thumb, as in all the other *Didelphidous Pedimana*, is without a claw. The fore-fingers are separate, very long and slender, (the middle and ring-fingers

the longest of all,) and the last joint expanded and flattened as in the *Geckos*. The thumb is placed rather behind the general line of the other fingers, and seems at first sight to be opposable: it perfectly resembles those of the *American Monkeys*. The claws are very small and weak; they do not extend beyond the points of the fingers, nor even so far, and are absolutely useless either for climbing or burrowing. Considerably behind the others, on the outside of the wrist, there is a lengthened tubercle resembling a sixth finger, but much shorter than the others and without any bone. What purpose this unique organ may serve in the economy of the animal's life, it is impossible to conjecture, but the long, slender fingers are probably used to pick out the food which it carries in the cheek-pouches."

AFRICAN BIRDS.

June 14.—Specimens were exhibited of various *Birds* from Northern Africa, which had recently been presented to the Society by Sir Thomas Reade, Corr. Memb. Z. S. They included the *Anas marmorata*, Temm., on which Mr. Gould remarked that in the form of the bill it approached nearly to the *Pin-tailed Duck*, *Anas acuta*, Linn., although it is altogether destitute of the elongation of the middle tail-feathers which occur in that bird; the *crested Duck*; the *Gadwall*; the *Garganey*; the *Ruff*, and the *black-tailed Godwit*, in their winter dress; the *Golden Oriole*; and other species: all of which were severally brought under the notice of the Meeting by Mr. Gould, at the request of the chairman.

Mr. Gould subsequently exhibited specimens of various *Birds* which he had recently received from M. Temminck: including a new species of *Ptarmigan* from Siberia; and a *Trogon* from the Indian islands, nearly allied in almost every particular to the *Trog. erythrocephala* of the Himalaya, but having the wing fully an inch shorter, with a tail bearing a relative proportion.

The Secretary announced the arrival in the Menagerie, since the last Meeting of the Society, of the four *Giraffes*, the capture of which was described by M. Thibaut in a letter read at the Meeting on February 9, 1836, and translated in the present volume, at p. 144.

He also directed the attention of the Members to a specimen of *Temminck's Horned Pheasant*, *Tragopon Temminckii*, Gray, which had recently been added to the Menagerie by the liberality of J. R. Reeves, Esq., of Canton: to a pair of the *Serin Finch*, *Fringilla Serinus*, Linn., brought from Italy for the Society, and presented to it by Mr. Willimott; and to a monstrous variety of the *Indian Tortoise*, *Testudo Indica*, Linn., which had also been lately added to the Menagerie, and which is remarkable for the great irregularity of the surface of its shell, each of the plates being raised into high conical eminences.

THE SEA OTTER.

A paper was read by Mr. Martin "On the Osteology of the Sea Otter, *Enhydra marina*, Flem." It is founded on a perfect skeleton of the animal contained in the collection made by that energetic traveller the late David Douglas, and acquired, subsequently to his decease, by the Society. This skeleton was exhibited.

Mr. Martin refers, in the first instance, to the dentary characters of this remarkable animal, which were correctly described and figured by Home, in the Philosophical Transactions for 1796; and then adverts to

some erroneous statements which have since been made respecting its molar teeth by various authors, including Cuvier, who appear to have possessed no opportunities of examining specimens. In the course of his communication, he describes in detail the number and form of the teeth, which consist of six incisors in the upper jaw, and of four in the lower, the outer one on each side in either series being larger than the others, and assuming, in the upper jaw, somewhat of the form of the canines; of a strong canine on each side of the incisors in either jaw, and of four molars on either side in the upper, and five in the lower jaw, of which two in the upper and three in the lower are false and successively increase in size towards the true molars, the latter being large, broad teeth, with flattened crowns somewhat depressed in the middle: in the upper jaw the hindermost of the true molars is much larger than the other, while in the lower it is comparatively small.

Mr. Martin concluded by remarking that as the hinder extremities are placed far backwards, and when stretched out in the act of swimming exceed the tail, this organ will appear placed between them, almost as much as it is in the Seals; between which animals and the Otters the *Enhydra* forms, in his estimation, a palpable link of union, approximating in some portion of its osseous structure, even more to the former than to the latter.

Mr. Martin added that it was his intention, with the view of rendering his communication more complete, to review the osteology of the *Enhydra* in detailed comparison with that of the common Otter and the Seal.

NEW ANIMAL FROM AUSTRALIA.

be found to belong to the *marsupial* type.

The skin on which this description was founded had been lent to Mr. Waterhouse, for the purpose of describing, by Lieut. Dale, of Liverpool, who procured it whilst on an exploring party in the interior of the Swan River Settlement, about 90 miles to the S.E. of the mouth of that river. Two specimens were seen; both of which took to hollow trees on being pursued, and one of them was unfortunately burned to death in the attempt to dislodge it from its retreat. The country abounded with decayed trees and ant-hills; and Mr. Waterhouse is of opinion, from this circumstance, and from some peculiarities in the structure of the animal, that it lives chiefly, if not wholly, upon ants, for which reason he proposes for it the generic name of

Myrmecobius.

Dentes incisores $\frac{8}{6}$, canini $\frac{0\text{--}0}{1\text{--}1}$, pseudo-molares $\frac{5\text{--}5}{4\text{--}4}$, molares $\frac{3\text{--}3}{4\text{--}4} = 48$.

Pedes antici 5-dactyli, digitis tribus intermediis longioribus; postici 4-dactyli, digitis duobus intermediis internum superantibus; externo brevissimo; unguibus longis acutis subfalcularibus. Scelides antipedibus longiores. Caput elongatum; rhinario producto: auriculis mediocribus acutis. Corpus gracile. Cauda mediocris.

Mr. Waterhouse details at length the peculiarities of the dentition and other structural characters of the animal under consideration, and particularly notices the statement of Lieut. Dale that, when it was

killed, the tongue was protruded from the mouth to the extent of two inches beyond the tip of the nose, its breadth being three sixteenths of an inch; which circumstance, combined with the dentition of the animal, confirms him in the belief that it feeds upon ants. With respect to its immediate affinities, he confesses himself at a loss. In skinning the specimen, the part where the pouch would be placed in a marsupial animal, has been so mutilated as to render it difficult to determine whether or not it possessed one: it appears, however, to have been a female, and to have two *mammæ* and the remains of a pouch. Mr. Waterhouse is of opinion that it will prove to be allied to the genus *Phascogale*; and there are also, he states, points of resemblance between it and *Tupaia*, as well as with the ground squirrels, the genus *Tamias* of modern authors.

The species Mr. Waterhouse proposes to name *Myrmecobius fasciatus*: he describes it as follows: "Length from the nose to the root of the tail, (measuring along the curve of the back,) ten inches; of the head, from the tip of the nose to the base of the ear, one inch and seven-eighths; of the tail, six inches and a quarter. The colour above is reddish ochre, interspersed with white hairs, the posterior half of the body being adorned with alternate black and white transverse fasciæ, disposed in a manner somewhat similar to those of *Thylacinus cynocephalus*. The under parts of the body are yellowish white; the anterior legs of the same colour on their inner sides, and of a pale buff colour externally; and the posterior legs of a pale buff colour, with the fore-part of the tibiæ whitish, and the sole entirely bare. The hairs of the tail are mixed, black, white, and reddish ochre; each of these colours predominating in different parts. The reddish hue of the fore part of the body is gradually blended into the black, which is the prevailing colour of the posterior half, and which is adorned with nine white fasciæ; the first of these fasciæ (which is indistinct) commences rather before the middle of the body, and being, in common with the second, interrupted on the back by the ground colour of the body; the third, fourth, and last extending uninterruptedly from side to side; and the fifth, sixth, seventh, and eighth, extending over the back, passing without coming into contact, and thus, as it were, dovetailing with those of the opposite side. The hair on the head is very short, and of a brownish hue above, (being composed of a mixture of black and reddish brown, with a few white hairs); and whitish beneath. The nose and lips are blackish; and there are a few long black hairs springing from under the eyes and from the sides of the muzzle. The body is covered with hair of two kinds; the outer of which is moderately long, rather coarse, and compact on the back and fore parts of the body; but over the haunches, and on the under surface, where the pouch is situated in the Marsupials, the hair is long. The under fur is short, fine, and rather scanty. The tail is furnished throughout with long hairs."

In illustration of his paper, Mr. Waterhouse exhibited the skin, together with drawings of the animal, of its skull, and of its dentary characters.

BOTANY.

OBSERVATIONS AND EXPERIMENTS ON THE COLOURED AND COLOURABLE MATTERS IN THE LEAVES AND FLOWERS OF PLANTS.

By Dr. Hope, V.P.R.S.E., F.R.S.

AFTER premising some general remarks respecting the object of research, and enumerating the various authors who had written upon the subject, Dr. Hope explained various terms which were to be used in the discourse. To the various coloured matters presented by the leaves and flowers of plants, De Candolle had applied the denomination of Chromule, which term he meant to adopt.

There resides in the same parts of plants, in addition to the chromule, some matter probably destitute of colour, which becomes red by the action of acids, and yellow or green by the action of alkalies. To it Mr. Ellis gave the name of colourable matter, which the author changes to Chromogen. When an acid, added to a vegetable infusion, causes a red colour, and an alkali a yellow or green, it has been the universal opinion that both sets of agents act upon one and the same colourable principle. The leading object of this paper is to show that the Chromogen, or colourable principle, is not an individual substance; and that there are two distinct principles, one which forms the red compound with acids, which he denominates Erythrogen; and another, which affords a yellow compound with alkalies, which he calls Xanthogen.

To establish that opinion, Dr. Hope made many experiments on the leaves and flowers of plants, with various reagents, principally water, alcohol, acids, and alkalies; and has exhibited the results in the compendious form of tables. The first table presents the result of experiments on the leaves of many plants; and the general result from them, in regard to the special object of inquiry, is, that in addition to the green Chromule, denominated Chlorophyle by many writers, they all contain Xanthogen, and that none of them, excepting those which have some tint different from the green, contain Erythrogen.

The second table exhibits the result of the action of the reagents upon white flowers, all of which, to the number of about thirty, gave proofs of their containing Xanthogen, but no Erythrogen nor tinted Chromule of any kind.

The third table displays the results with yellow flowers, from

which the general inferences are, that the yellow Chromule varies in its nature in different flowers; that all those subjected to experiment contained Xanthogen, and none of them Erythrogen.

The fourth table exhibits the experiments with red flowers, and affords the general conclusions, that while the red Chromule shows considerable variety of character, red flowers contain both Xanthogen and Erythrogen in abundance.

The fifth table exhibits the results with twenty blue flowers, and presented the general observations, that the blue Chromule varies in its character in different blossoms, particularly in showing very different degrees of solubility in water and alcohol, and in some producing coloured, and in others colourless, solutions in both menstrua; and that they contain both the colourable principles of Xanthogen and Erythrogen.

The sixth table relates to ten orange flowers, which equally shows that the orange Chromule differs much in one plant from another, and that they contain both colourable principles.

The seventh table relates to twenty purple flowers, and afforded the same conclusions as the preceding.

The eight table exhibits the experiments made upon the tinted Chromule found in other parts of plants, beside the corolla of the flowers, *e. g.* the calyx, bractea, the coloured leaves of plants, fruits, and surface of the roots, all which comported themselves as the corresponding coloured Chromules of the flowers do.

Litmus presented a solitary example, but a very interesting one in this inquiry, of a substance abounding largely in Erythrogen, but containing no Xanthogen.

A table was also presented, exhibiting the general facts relative to the power of sulphurous acid in decolorizing the Chromules of plants. This acid, whether employed in its gaseous or liquid form, does not decolorize the Chlorophyle of leaves. It does not affect white flowers. It did not decolorize any one of about a score of yellow flowers submitted to its action. Of thirty or forty red flowers it decolorized all, with the exception of two or three. Of twenty blue flowers, two, the *Commelina cœrulea*, and the blue *Centaurea Cyanus*, resisted its blanching power. It decolorized some of the orange-coloured flowers, but rendered others of them of a bright yellow; it decolorized all the purple flowers that were tried, with the exception of purple *Centaurea Cyanus*, which it rendered blue, and the purple *Scabiosa atropurpurea*, which it reddened. It affected the tinted Chromule occurring in other parts of plants than blossoms; it completely blanches the internal leaves of the red cabbage, which are of a bright purple red, while it renders the external bluish-purple leaves green. It turned to green various leaves, which possessed red tints, whether general over the whole leaf, as the red beet, or partially diffused, as in some species of Dracæna. It decolorizes some fruits, while others resist its action.

Along with the general facts, the various hypotheses respecting the origin of the different Chromules, and sources of the differences amongst them, the autumnal coloration of leaves, &c., were brought under consideration.

Lastly, a detail was given of the influence of light in the production of different Chromules, showing that it is indispensable for the production of the Chlorophyle of leaves, and the tinted Chromules formed during the autumnal coloration of the same parts; and that it is not indispensable for the formation of some of the finest tints of flowers and fruits, if essential for any.

The paper terminated with the following general conclusion:—That there exist in plants two distinct colourable principles, two species of Chromogen, one which generates red compounds with acids, and denominated Erythrogen; and another which forms yellow compounds with alkalies, called Xanthogen. That these two principles occur together in red and blue flowers, and in the leaves of a few plants which exhibit the former of these tints; that all green leaves, all white and all yellow flowers, and white fruits, contain Xanthogen alone; that Litmus abounds in Erythrogen, but has no Xanthogen; that the Chromules of different tints may be generally considered distinct vegetable principles, or compounds having their own proper hue; sometimes intimately blended, or chemically combined with Chromogen; at other times having no connexion with it; that they are also occasionally, but not frequently, compounds of Chromogen with acids or alkalies.*

SOURCES AND COMPOSITION OF THE DIFFERENT KINDS OF GAMBOGE. *By Dr. Christison.*—BOTANICAL ORIGIN OF GAMBOGE. *By Dr. Graham.*

GAMBOGE was first made known by Clusius about the commencement of the seventeenth century, as a concrete juice from China. About the middle of the same century, Bontius conceived he had traced it to a particular species of *Euphorbia*, growing in Java and in Siam; from the latter of which countries the whole gamboge of commerce was at that time obtained. About the close of that century Hermann announced that gamboge was produced by two species of trees growing in Ceylon, which have been since often confounded together, but which are now designated by the names *Garcinia Gambogia*, and *Stalagmitis Gambogioides*. About the middle of last century, gamboge was referred by Linnæus to the former of these plants, and his reference was generally admitted. But about thirty years later, Professor Murray of Göttingen conceived he had traced it satisfactorily from the specimens collected by Koenig in Ceylon, and information obtained by the same botanist in Siam, to a new species which he called *Stalagmitis Gambogioides*.

* Jameson's Journal, No. 42.

Dr. Graham shows, from specimens and drawings sent from Ceylon, both by Mrs. Colonel Walker to himself, and by David Anderson Blair, Esq., to the late Dr. Duncan that the plant producing Ceylon gamboge is neither *Garcinia gambogia*, as Linnæus thought, nor *Xanthochymus ovalifolius*, as conjectured by Dr. Wight and Mr. Arnott, nor *Stalagmitis gambogioides*, according to Murray and Koenig, but is a species described by Lamarck and Gärtner under the name of *Garcinia* or *Mangostana morella*, although it differs from all of these genera in the structure of its stamens, and, therefore, probably ought to be considered a new genus among those producing a gambogioid juice.

Dr. Christison proved, that, at the present time, Ceylon gamboge is not an article of European commerce, and that the whole gamboge of the markets of this country comes, as in the time of Bontius, from China. After mentioning the analysis of fine gamboge made by Braconnot in France and John in Prussia, he stated the following as the mean composition of the several varieties of gamboge he has hitherto examined:—

Pipe gamboge of Siam: Resin, 72·2; Arabin, 23·0; Moisture, 4·8; =100·0. Cake gamboge of Siam: Resin, 64·8; Arabin, 20·2; Fecula, 5·6; Lignin, 5·3; Moisture, 4·1; =100·0. Ceylon gamboge sent by Mrs. Colonel Walker: Resin, 70·2; Arabin, 19·6; Fibre of wood and bark, 5·6; Moisture, 4·6: Ceylon gamboge, adhering to a specimen of the bark sent by Mr. David Anderson Blaire: Resin, 75·5; Arabin, 18·3; Cerasin, 0·7; Moisture, 4·8; =99·3.

The proportion of the gum to the resin varied somewhat in variety, but never differed more than 2 per cent. from the means given above.

The author added, that he had found the resin to be the active principle of gamboge.

He inferred from the composition of the different kinds of gamboge, and other circumstances detailed in his paper, that the cake gamboge of Siam is not entirely a natural production, but a manufactured article; that Ceylon gamboge, if freed from incidental fibrous matter, corresponds almost exactly with Siam gamboge: that, therefore, they are probably produced by the same plant: that Ceylon gamboge possesses precisely the same medicinal properties; and that this variety, if more carefully collected, may, in all probability, be applied with equal advantage to every economical purpose which is at present served by the finest pipe gamboge of Siam.*

GROWTH OF WHEAT.

On the anniversary of the British Association, Mr. G. Webb Hall read a communication "On the Acceleration of the Growth of Wheat." After pointing out the advantages which might accrue

* Proceedings of the Royal Society of Edinburgh; quoted in Jameson's Journal, No. 41.

to agriculture from the attention given by scientific men to certain subjects with which it was connected; and the absolute necessity which now existed for making the most extensive and careful investigations concerning many points of great importance to the success of agriculture, he proceeded to call the attention of the Section to a statement of facts, by which it would be seen that the usual period allotted to the occupation of the ground for a crop of wheat might be very materially abridged. At an average, this might be estimated at ten months, though twelve, and even thirteen, were not unusual, and eight might be considered as the shortest period for the ordinary winter wheat. By a selection of particular seed, and a choice of peculiar situation, wheat sown early in March has been, on different occasions, ripened before the middle of August, a period scarcely exceeding five months. Mr Hall considers it an unquestionable law of vegetation that the offspring of a plant of early maturity itself, seeks to become so likewise, even when placed in unpropitious circumstances, and that it recedes with reluctance from the condition of its parent. Hence the seed of a crop which had been ripened in five months has a better prospect of producing another crop equally accelerated than that from a crop which had been longer in ripening. He also asserted, that the acceleration of a crop was farther promoted by thick sowing, which likewise might be considered advantageous in checking the mildew.

Dr. Richardson referred to the remark of Humboldt, that in South America the wheat crop was ripened in ninety days from the period of sowing, and stated, that about Hudson's Bay this period was only seventy days. He suggested the probable advantage that might arise from importing seed from the latter country for the purpose of furthering Mr. Hall's views: but this gentleman stated, that he had found that seed imported from a distance (and he had tried some from Italy) was liable to become diseased.

As connected with the subject of the acceleration of the growth of seeds, Professor Henslow next mentioned the results of experiments which he had tried upon seeds of a species of Acacia, sent by Sir John Herschel from the Cape of Good Hope, with directions that they should be steeped in boiling water before they were sown. Some of these were kept at the boiling temperature for three, six, and fifteen minutes respectively, and had yet germinated very readily in the open border; whilst those which had not been steeped did not vegetate. It was suggested that these facts might lead to beneficial results, by showing agriculturists that they may possibly be able to steep various seeds in water sufficiently heated to destroy certain fungi or insects known to be destructive to them, without injuring the vital principle in the seed itself.

Mr. Hope incidentally mentioned a practice common in some parts of Spain, of baking corn to a certain extent, by exposing it

to a temperature of 150° or upwards, for the purpose of destroying an insect by which it was liable to be attacked.—Dr. Richardson mentioned, that the seeds sold in China for the European market were previously boiled, for the purpose of destroying their vitality, as the jealousy of that people made them anxious to prevent their exportation in a state fitted for germination. Upon sowing these seeds he had nevertheless observed some few of them were still capable of vegetating.*

SUGARCANDY IN FLOWERS.—STIMULUS OF BOILING WATER TO SEEDS. A NOTICE OF THE FACT, AND OF PARTICULARS ON THE MODE, OF SUGARCANDY BEING PRODUCED IN THE FLOWERS OF RHODODENDRON PONTICUM L.; AND A NOTICE OF THE EFFECT ON THE GERMINATION OF THE SEEDS OF AN ACACIA NECKER OF BOILING THEM VARIOUSLY.

By the Rev. J. S. Henslow, M.A., Professor of Botany in the University of Cambridge.

On Crystals of Sugarcandy formed by the Flowers of Rhododendron ponticum L.—I was lately shown several crystallized fragments of what appeared to be white sugarcandy, which were found in the decaying flowers of a plant of Rhododéndron pónticum L. That I might observe the manner in which they had been formed, the plant was left with me for a few days; but, unfortunately, the blossoms had all fallen, and nothing remained of the flowers but the abortive ovaries, already more or less withered. On some of these there was still a drop of a thick transparent saccharine fluid, evidently of the same flavour and composition as the crystals. I washed those ovaries which seemed to possess the most vitality: and, at the end of a few hours there was a decided exhibition of a fresh supply of the syrup from several of them. This syrup gradually hardened, like a drop of gum, into a solid transparent, and perfectly colourless, mass; but those which I had received before exhibited some distinct crystalline facets, above a line in length. The largest mass was three lines long, and two broad, and weighed as much as four-tenths of a grain. Eight fragments from different flowers weighed, together, 1·8 grain. In the *Gardeners' Magazine*, vol. iii. p. 208, is the following notice, extracted from the *Bulletin Universel*:—

"Rhododéndron pónticum is found to contain some grains of common sugar, of a pure and white colour, on the surface of the upper division of the corolla." The present example appears to offer the same substance, in larger masses than those here alluded to. "I find that the syrup always exudes from the upper surface of the thickened base upon which the ovary is seated, and, apparently, from a minute glandular spot placed between the sinus formed by the two upper teeth of the calyx. The excessive for-

* Jameson's Journal, No. 42.

mation of the syrup, in the present example, may be ascribed to a morbid state of the plant, which was in a pot, and kept in a room; the crystals were stated to have been found more particularly within some of the flowers which had withered without fully expanding.

On the Stimulus afforded to the Germination of the Seeds of an Acacia by their being scalded with boiling Water.—Sir John Herschel lately sent some seeds of an acacia from the Cape of Good Hope, to Captain Smith of Bedford, with directions that they should be scalded, in order to secure their germination. Captain Smith having presented me with a dozen of these, I subjected them to the following experiments:—Two were placed in boiling water, and left to soak for an hour, until the water had become cool; two were kept at the boiling temperature for 1½ minute; two for 3 minutes; two for 6 minutes; and one for 15 minutes. Some of these were sown immediately, under a handglass, in the open border; and the rest were kept for 3 or 4 days, and then sown in a hot-bed. The following are the results obtained:—

Under the hand-glass,—

1, boiled for	1½	minute, failed.	
1 ..	3	minutes, came up in	14 days.
1 ..	6	.. .. ..	13 days.
1, not steeped at all, did not germinate.			

In the hot-bed.—

1, boiled for	1½	minute, came up in	8 days.
1 ..	3	minutes	7 days.
1 ..	6	.. .. ..	7 days.
1 ..	15	.. .. ..	13 days.
2, in boiling water, left to cool ..			9 days.
2, not steeped		.. .. ..	21 days.

We cannot draw any decided inference from the single seed, which was boiled for 15 minutes, having been more retarded than the rest, as it might have been a bad specimen; but it seems very clear, that the heat to which these seeds were exposed must have acted as a decided stimulus to their germination; whilst it is a very singular fact, that they should not have been completely destroyed by it. Had I supposed it probable that the seed which was boiled for 15 minutes would have germinated, I should have boiled some of the others still longer, in order to ascertain the extreme limit to which such severe treatment might be carried without destroying the vital principle.*

FOSSIL FERNS.

The following general conclusions regarding the geological and geographical distribution of fossil ferns, are contained in a recent

* Magazine of Natural History, No. 65.

memoir by Professor Göppert. The beds of the coal formation contain the largest number of fossil ferns, viz. 182, while the muschelkalk, and the chalk and tertiary formations, contain the smallest number. The total number of these fossil vegetables at present known amounts to 253, of which 92 have been found in Silesia, 29 in Bohemia, 56 in the other countries of Germany, 49 in France and Belgium, 89 in Great Britain, 3 in Denmark and Sweden, 1 in Italy, 11 in North America, 1 in Holland, and 4 in the East Indies. The ferns that are the most widely distributed on the globe are the following:—*Alethopteris Serlii* (in England, France, Silesia, Pennsylvania), *Neuropteris angustifolia* and *N. abutifolia* (in England, Bohemia, Silesia, Pennsylvania), and *N. Lohsii* (in England, France, Belgium, in the districts of the middle Rhine, in Bohemia, and Silesia). Most of the ferns of the Jura formation occur in England. The number of fossil ferns amounts nearly to a third of the total number (800) of fossil vegetables at present known. But it is very probable that we are acquainted with but a small portion of these fossils. Several genera of ferns belong exclusively to one or to two formations. Thus, the following occur only in the coal formation:—*Gleichenites*, *Balantites*, *Beinertia*, *Bockschia*, *Danæites*, *Diplacites*, *Glockeria*, *Glossopteris*, *Steffensia*, *Woodwardites;* and the same formation contains also the most of the species of the genera *Asplenites*, *Adiantites*, *Aspidites*, *Alethopteris*, *Cheilanthites*, *Cyatheites*, *Hemitelites*, *Neuropteris*, *Odontopteris*, *Trichomanites*, and *Hymenophyllites*. The two genera *Anomopteris* and *Scolopendrites* are peculiar to the *grès bigarré*. The genus *Asterocarpus* occurs in the coal formation, and also in the *Keuper*, *Pachypteris* only in the Jura series, and most of the species of *Acrostichites* and *Polypodites* in the same formation. Fossil ferns of all formations, without even excepting those of the chalk and the *Molasse*, present a striking resemblance to the tropical species of ferns, but none to those of temperate and cold climates. One of the principal conclusions to be drawn from the geological distribution of fossil ferns is, that each formation has particular species, which differ essentially from those of other formations. To this there are very few exceptions. Silesia is remarkable for its extremely rich fossil flora, for no less than 230 species have already been found in that country. The fossil flora of England resembles greatly that of Silesia. Excepting the genus *Stigmaria*, which is common to the transition and the coal formations, no species has been found in two formations. Finally, it is remarkable that dicotyledons and junci occur both in the most ancient and in the most modern deposits, a fact which tends to prove that there is little foundation for the opinion that at the earliest epochs cellular plants only existed, afterwards monocotyledons, and then at a later period dicotyledons.*

* Jameson's Journal, No. 41.

EFFECTS OF ARSENIC ON VEGETATION.

Dr. Daubeny has communicated to the British Association the partial results which he has obtained from a series of experiments he was carrying on at Oxford, respecting the effects which arsenic produces on vegetation. He was led to undertake these experiments from having received a communication from Mr. Davies Gilbert, in which he stated that there was a district in Cornwall where the soil contained a large proportion of arsenic; and that no plants could grow in it except some of the leguminosæ. By analysis, this soil yielded him about 50 per cent. of arsenic, in the form of a sulphuret; the rest being composed principally of sulphuret of iron and a little silica. He had already ascertained that a little of the sulphuret mixed in soils produced no injurious effect on *Sinapis alba*, barley, or beans; and that they flowered and seeded freely when grown in it. Although the want of solubility in the sulphuret might be assigned as a reason for its inactivity; yet it was certainly taken up by water in small quantities, and imbibed by the roots of plants. Upon watering them with a solution of arsenious acid, he found that they would bear it in larger proportions than was presupposed. The injurious effects of arsenious acid on vegetation in the neighbourhood of the copper-works of Bristol and Swansea was noticed by Mr. Rootsey; and Mr. Stevens mentioned the circumstance of the trout in some streams of Cornwall having been destroyed by the opening of some new mines in their neighbourhood, from which arsenical compounds were discharged, though the vegetation did not appear to be injured by them; and it was further stated, that horses were considerably injured, and rendered subject to a remarkable disease, by the effects of arsenical compounds in the same districts.*

LONGEVITY OF THE YEW-TREE.

Mr. Bowman read a communication, at the anniversary of the British Association, respecting the longevity of the yew-tree; and mentioned the result of his observations upon the growth of several young trees, by which it appeared that their diameters increased during the first 120 years, at the rate of at least 2 lines, or the one-sixth of an inch, per annum; and that, under favourable circumstances, the growth was still more rapid. In the church-yard at Gresford, near Wrexham, North Wales, are eighteen yew-trees, which are stated by the parish register for 1726 to have been planted in that year. The average of the diameters of these trees is 20 inches. Mr. Bowman then remarked on two yew-trees of large dimensions, from the trunks of which he had obtained sections. One is in the same church-

* Jameson's Journal, No. 42.

-yard as those above-mentioned, and its trunk is 22 feet in circumference at the base, 29 feet below the first branches. This gives us a mean diameter of 1224 lines, which, according to De Candolle's rule for estimating the age of the yew, ought also to indicate the number of years. From three sections obtained from this tree, Mr. Bowman ascertained that the average number of rings deposited for one inch in depth of its latest growth, was 34⅔. Comparing this with the data obtained from the eighteen young trees, he estimated the probable age of this tree at 1,419 years. The second of these trees is in the church-yard of Darley in the Dale, Derbyshire; and its mean diameter, taken from measurements at four different places, is 1,356 lines. Horizontal sections from its north and south sides gave an average for its latest increase at 44 rings per inch nearly, which gives 2,006 years as its age, by the mode of calculation adopted by Mr. Bowman. He then proceeded to state his opinion of the reason why so many old yew-trees were to be met with in church-yards: he considered that they might have been planted there at a period anterior to the introduction of Christianity, under the influence of the same feelings as those which prompted the early nations of antiquity to plant the cypress round the graves of their deceased friends.*

GEOLOGY.

VERTEBRATED ANIMALS FOUND IN THE CRAG OF NORFOLK AND SUFFOLK.

At the anniversary of the British Association, a memoir was read by Mr. E. Charlesworth, on Vertebrated Animals found in the Crag of Norfolk and Suffolk. The principal object in bringing forward this subject, was to establish the fact of the remains of mammiferous animals being associated with the mollusca of the tertiary beds above the London clay, in the eastern counties of England. These remains are confined to a part of the Crag formation, which appears to extend from Cromer in Norfolk, to within a few miles of Aldborough in Suffolk, and the depth of which was very great, wells having been sunk in it without reaching its bottom. The bones of fish, and a large portion of the testacea met with in the stratum, differ widely from those of the coralline beds, and from that part of the Crag deposit which skirts the southern coast of Essex and Suffolk. Among the mammalia, which the author states really belong to the Crag, is the *Mastodon angustidens*, of which several teeth

* Jameson's Journal, No. 42.

have recently been obtained in Norfolk from localities adjoining the parish of Withingham, the spot from which Dr. W. Smith states the specimen to have been procured which is figured in his "Strata Identified." Mr. Charlesworth conceived the discovery of the remains of the mastodon in this formation, as affording an argument to prove the relative ages of these rocks, as no remains of this animal have been found in America in beds more ancient than the diluvial. The remaining genera of mammiferous animals can be identified with those now existing, or with such as are found in diluvial and lacustrine deposits. The author next notices the discovery of the mineralized remains of birds, chiefly bones of the extremities of natatorial tribes, a solitary instance of a similar discovery in America being the only one recorded. He was not prepared to speak concerning the different kinds of fish, but he stated their distribution—species of Squalus being found near Orford, and what Agassiz conceives to be Platex, at Cromer. Among the most remarkable is the Carcharias megalodon, the teeth of which are found in Suffolk, equal in size to specimens from the tertiary formations of Malta. He also alluded to the difference of the testacea in different parts of the Crag, from which he was inclined to infer there were several eras in its formation. No traces of the existence of reptilia have yet been detected, which would rather support the opinion of Dr. Beck and Deshayes, that the climate during the Crag epoch was analogous to that of the Polar regions.—Professor Sedgwick stated, that he had been long aware of the existence of remains of mammalia in the Norfolk Crag, although this had been disputed by Mr. Conybeare, in his work on the Geology of England and Wales. He was rather inclined to consider the Crag as all of one epoch; and Mr. Lyell had found existing species as numerous in the lower as in the upper Crag. With regard to Mr. Charlesworth's idea of the extinction of the mastodon in England before the formation of the diluvial beds, Professor Sedgwick conceived that it was reasoning from a negative fact, and that until more extensive search had been made, no such inference could be fairly drawn. He also mentioned that remains of the beaver were found in the alluvians of Cambridgeshire, and that it might have existed in England a thousand years ago. He was confident that no cause still in existence could have produced the diluvium on the Crag; its whole appearance suggested the idea of a great rush of waters.—Mr. Conybeare was perfectly willing to correct his opinion respecting the existence of the remains of mammalia in the Crag. He was of opinion that the tertiary strata of America had not been sufficiently examined to justify the conclusion that it did not contain remains of the mastodon. He started a question—which of the species of mastodon found in other countries did the British one resemble?—Mr. Greenough mentioned, as a singular peculiarity of the diluvium of Norfolk, its containing large masses of chalk, which contain organic remains differing in some respects from those of the chalk *in situ*. The town of Cromer seemed to be built on an immense block of chalk, contained in the diluvial formation.—Mr Murchison dissented from Mr. Greenough's opinion. He conceived the formation of chalk was under the diluvium, and had been elevated and disrupted. He had seen at Hazeborough large platforms of chalk laid bare after a storm; near that place were needle-shaped rocks of chalk, and at Cromer the foundation of the town must rest on part of the same mass. There were strong reasons for believing that the Norfolk diluvium contained recent shells only. Mr. Lonsdale, on examination, could discover no others.—Mr. Charlesworth mentioned, that Dr. Beck consi-

dered the shells of the tertiary period to be extinct species, and that at the formation of the Norfolk Crag the climate must have been very cold, like the Arctic regions. He considered the diluvial formation to have been sufficiently searched to warrant an opinion that it does not contain the remains of the mastodon. Many singular organic remains have been found there, which have been transported, as of saurians, which must have come from Yorkshire. In alluding to the fact of shells similar to those of the Crag being found at Bridlington, he was informed by Mr. Sedgwick that the formation at that place was probably part of the Crag.*

FOSSIL SAURIAN REMAINS, NEAR BRISTOL.

On March 23, a paper was read before the Geological Society, entitled, "A Description of various Fossil Remains of three distinct Saurian animals discovered in the autumn of 1834, in the Magnesian Conglomerate on Durham Down, near Bristol." By Henry Rily, M.D. and Mr. Samuel Stutchbury; and communicated by Charles Lyell, Esq., P.G.S.

The conglomerate in which these Saurian remains were discovered rests upon the edge of inclined strata of mountain limestone, filling up the irregularities of their surface, and consists of angular fragments of the limestone cemented by a dolomitic paste. The thickness of the deposit at the point where the remains were discovered does not exceed twenty feet.

Of the three animals described in the paper, two belong to a genus for which the author proposes the name of Palæosaurus, and the third to one which they have called Thecodontosaurus.

The characters of the genus Palæosaurus are derived from the teeth, which are described as being carinated laterly, and finely serrated at right angles to the axis. They are stated to differ from those of all the Saurians known to the authors; and as the teeth in their possession exhibit minor marked characters, they are induced to consider that they belonged to two species, which they have named *P. cylindricum* and *P. Platyodon*.

The genus Thecodontosaurus is likewise founded on the structure of the teeth, and their having been deposited in distinct alveoli. Among other remains in the Museum of the Bristol Institution is the right ramus of a lower jaw, 3¼ inches long and 1¼ in the greatest depth, from the summits of the teeth to the under rise, consisting of the dental bone, containing 21 teeth, with portions of the sub-angular and complementary bones, and perhaps traces of the opercula. The alveolar groove for the reception of the teeth is formed by two ridges of nearly equal height, the teeth being deposited in it, in distinct alveoli, to nearly half their length. The teeth somewhat resemble in shape a surgeon's abscess-lancet, being acutely pointed and flattened; while the anterior edge is also curved, but concave and strongly serrated, the serrature being directed towards the apex of the tooth. The middle teeth are the largest, rising not less than a quarter of an inch above the socket. They all possess a conical hollow, and in a specimen belonging to the Rev. D. Williams a young tooth is well exhibited in one of the alveolar cavities. From these characters the authors infer that the jaw belonged to a Saurian, but not to the great genus Lacerta of Linnæus as reformed by Cuvier by rejecting the Crocodiles and Salamanders. They further infer from the shape and

* Jameson's Journal, No. 42.

serrated edge of the teeth that it did not belong to the Crocodiles; nor to the Lizards, whose alveolar inner edge is either wanting or much less elevated than the outer. They also show that it was not allied to the Monitors, because of the elevated inner alveolar edge, the distinct alveoli, the teeth remaining hollow and the formation of the new tooth in the same cell with the old one, as well as from the great number of the teeth. With respect to the Iguanas and Scinks they show that the fossil could not have belonged to them, in consequence of the distinct alveoli, the inner alveolar edge, and the form of the summit and serratures of the teeth: and that it differed from the Saurodon in having a ridge on the outside of the tooth with the edge crenated and of unequal length.

Numerous other bones have been discovered, but as none of them were found in connexion with teeth, the authors hesitate to assign them to either of the genera which they have established. Among these remains the following are described:—

Vertebræ possessing the peculiar characters, of having the centre of the body diminished one half in its transverse and vertical diameters so as to resemble an hour-glass; of a suture connecting the anular part or body with the processes; and in the extremities of the vertebræ being deeply concave. These characters the author conceives distinguish the fossil vertebræ from those of all recent Saurians.

A nearly perfect chevron bone; ribs, one flat and imperfect, the other round with a double head and a deep intercostal groove; a clavicle: portions of coracoids; a humerus, the articulatory extremeties of which expand to nearly three times the diameter of the centre of the bone; a humerus 7 inches long, 2 inches broad at the superior extremity, and 1¦ at its inferior; two femurs, one nearly-perfect, being 10 inches in length; part of an ischium; a tibia; a fibula; metacarpal or metatarsal bones, with penultimate and ungueal phalanges.

In conclusion the authors state that these remains afford further proof of the truth that the more ancient the strata the more the animal remains differ from existing types.*

ON THE PRESENCE OF COBALT AND OTHER METALS IN THE UPPER SANDSTONES OF THE TERTIARY FORMATIONS OF PARIS.

At the meeting of the Academy of Sciences of the 29th of February, M. Alexander Brongniert communicated a very interesting discovery recently made by the Duke of Luynes, who has detected the presence of cobalt in the proportion of at least 1 per cent. of manganese, and of traces of copper and arsenic, in the ferruginous sandstone of the abandoned quarry of St. Clair, near Orsay, and in that of the quarry of Seaux-les-Chartreux, near Palaiseau. In the "Geognosie du Bassin de Paris," published by Brongniart and Cuvier in 1822, mention is made of the occurrence of deposits of arenaceous limonite and scattered nodules of hydrate of iron, in the same position as the cobalt has now been found; and in 1835, M. Brongniart observed in the sand accompanying the millstones of the quarry of Tarteret a thin bed of red argillaceous sand, which from its external characters, he suspected to contain manganese; and this idea was confirmed by the analysis made by M. Malagutti. In the deposits of marly gypsum near Paris, manganese has been found in concretions, and having a dendritic arrangement; and zinc has been detected in the

† Philosophical Magazine, No. 50.

arenaceous limestones which form the transition from the gypsum formation to the calcaire grossier. Besides iron, manganese, and zinc, no other metal has hitherto been discovered in the tertiary series; but the discovery now announced proves that cobalt, a metal formerly regarded as one of the most ancient, whose presence had not been detected even in the chalk or Jura formations, either in veins or disseminated portions, exists disseminated, and in an original position, in the upper sandstone of Paris, that is, in the middle tertiary formation. In the present case the cobalt is accompanied by the substances generally associated with it, copper and arsenic, but also by manganese, which has never been found combined with it except in one instance. The only other authentic example of manganesian cobalt, being one mentioned by the Duke of Luynes himself, as occurring at Rengensdorf, in Alsace, at which locality a compound is found having great analogy to that of Orsay, but in a very different geological position, viz. in a vein of quartz traversing clay-slate. M. Brongniart remarks, that, if we carry our researches further, and examine what are the metals which have been brought to the surface of the earth during or after the tertiary period by volcanic action, we find that in lavas, basalts, trachytes, &c., there occur disseminated, iron, manganese, titanium, and copper, but no cobalt; and in veins, lead, zinc, antimony, silver, gold, and tellurium, but still no cobalt. Among the products of volcanos at present in action we find frequently arsenic, selenium, copper, and iron; but the only indication of cobalt hitherto discovered, was in a salt of cobalt observed by Davy in one instance in Vesuvius. M. Brongniart terminated his communication to the Academy by stating his belief that geologists, by careful investigation, will succeed in detecting manganese, cobalt, and zinc in other localities of tertiary rocks, for these metals "must have been introduced into the tertiary strata of Paris by powerful and, consequently, general causes, and there is no example on the face of the globe of a phenomenon limited to one single point."*

PHENOMENA OF ELEVATION.

At the anniversary of the British Association, a paper was read by Mr. Hopkins, containing theoretical views respecting the geological phenomena of Elevation. The principal object of the author in this paper was to investigate the effects of an elevating force acting simultaneously at every point, on portions of the crust of the globe of considerable superficial extent; and to show that the theoretical inferences deduced from this hypothesis are in striking accordance with the phenomena he had observed in the limestone and coal districts of Derbyshire. He also proved that in that district the direct cases of dislocation were not such as could result from the influence of the jointed structure as the determining cause of those directions. He pointed out how the theory he had discussed will account for nearly all the phenomena of mineral veins, which can be attributed to mechanical causes; as well as for the formation of systems of anticlinal lines, of faults, and of the phenomena of elevation.—Mr. Sedgwick considered this as the most important communication as yet made to the Section. We should now be enabled to indulge, in the same speculations in Geology, as in her elder sister science Astronomy, and from the beginning now made, it was impossible to predict

* Jameson's Journal, No. 40.

how far investigations like Mr. Hopkins' might eventually be carried. The observations of Mr. Hopkins held true in Cumberland, Derbyshire, and Flintshire; and some of his cases of complicated dislocation were admirably illustrated in Caernarvon and Stainmore. Mr. Sedgwick had himself paid particular attention to the joints of rocks, and had found them connected both with their strike and dip. He had also observed some singular phenomena in the Westmoreland slates; he had seen in them two sorts of joints, and a cleavage which was in a different direction from the jointing. In South Wales the planes of splitting were in one direction with very few exceptions.—Mr. Phillips expressed his high satisfaction at the result of Mr. Hopkins' paper, and expressed a hope that the phenomena of geology might, to a certain extent, be explained by such simple laws as regulate the other branches of physical science. With regard to the structure of rocks, which promised to throw so much light upon the subject, he proposed a new term for it, the *symmetrical* structure. In the examination of rocks under the three classes of Calcareous, Arenaceous, and Argillaceous, he had remarked, that the regularity of the structure increased with the antiquity of the rock, which was well exemplified in the older slates and limestones. For this there must be a cause, and this must be a central heat, which has acted most upon the older formations, and least upon the new. Illustrations of the effects of heat upon strata may be obtained from those in contact with dykes, which produce symmetrical structure in rocks or clays through which they pass. Internal heat must then have caused the regular structure so generally observed in rocks. The direction of the fissures pointed out by Mr. Hopkins in Derbyshire, corresponded with the observations of Mr. De la Beche in Cornwall, and of Mr. Conybeare in Glamorganshire. The phenomena of the direction of the joints were well worth investigation, as there was much uncertainty involved. They evidently pointed out the weaker points, or places of least resistance, where the disturbing force would operate with most effect; and they may have been the result of consolidation, as we find them in conglomeraters, as well as in homogeneous rocks; still it might be a question, if they were formed before or after dislocation.*

TRANSPORTATION OF ROCKS OF ICE.

On January 6, 1836, a notice on the transportation of rocks by ice, extracted from a letter of Capt. Bayfield, R.N., addressed to Charles Lyell, Esq., P.G.S., was read before the Geological Society.

Capt. Bayfield says that both on the lakes of Canada and in the St. Lawrence he has seen fragmentary rocks carried by ice. The St. Lawrence is low in winter, and the loose ice accumulating on the extensive shoals which line each side of the river is frozen into a solid mass, being exposed to a temperature sometimes 30° below zero. The shoals are thickly strewed with boulders, which become entangled in the ice; and in the spring, when the river rises from the melting of the snow, the packs are floated off, frequently conveying the boulders for great distances. It is also well known that stones are carried by the ice. Anchors laid down within high-water mark to secure vessels hauled on shore for the winter, are cut out of the ice on the approach of spring, or they would be carried away. In 1834, the Gulnare's bower-anchor, weighing half a ton,

* Jameson's Journal, No. 42.

was transported some yards by the ice, and so firmly was it fixed, that the force of the moving ice broke a chain cable as large as that of a 10 gun brig, and which had rode the Gulnare during the heaviest gales in the Gulf. The anchor was cut out of the ice, or it would have been carried into deep water and lost.

With respect to rocks being transported by icebergs, Capt. Bayfield's testimony is equally conclusive, as he passed three seasons in the vicinity of the Strait of Belleisle. In an iceberg which he examined, boulders, gravel, and stones were thickly imbedded; and he saw others which owed their dirty colour to the same cause. Some of these immense ice-islands, Capt. Bayfield thinks, had been detached from the coast very far to the northward, perhaps from Baffin's Bay. The northern current brings similar masses in great numbers down the coast of Labrador every year, and they are very frequently carried through the straits, and for several hundred miles to the S. W. up the Gulf of St. Lawrence.*

SUBSIDENCE OF THE COAST OF GREENLAND.

In a letter from Dr. Pingel of Copenhagan, to the President of the Geological Society of London, it is stated that the first observations which led to the supposition that the west coast of Greenland had subsided, were made by Arctander between 1777 and 1779. He noticed, in the firth called Igalliko, (lat 60° 43′ N.), that a small, low, rocky island, about a gun-shot from the shore, was almost entirely submerged at spring tides, yet there were on it the walls of a house fifty-two feet in length, thirty feet in breadth, five feet thick, and six feet high. Half a century later, when Dr. Pingel visited the island, the whole of it was so far submerged that the ruins alone rose above the waters. The colony of Julianahaab was founded in the mouth of the same firth in 1776: and near a rock, called the Castle by the Danish colonists, are the foundations of their storehouse, which are now dry only at very low water. The neighbourhood of the colony of Frederickehaab (lat. 62° N.), was once inhabited by the Greenlanders, but the only vestige of their dwelling is a heap of stones, over which the firth flows at high water. Near the well known glacier which separates the district of Frederickehaab from that of Fiskenass, is a group of islands called Fulluartalik, now deserted; but on the shore are the ruins of winter dwellings, which are often overflowed. Half a mile to the west of the village of Fiskenass, (lat. 63° 4′ N.), the Moravians founded, in 1758, the establishment called Lichtenfield. In thirty or forty years they were obliged once, perhaps twice, to move the poles upon which they set their large boats, called umiak or women's boat. The old poles still remain as silent witnesses, but beneath the water. To the north-east of the mother colony Godthaab, (lat. 64° 10′ N.), is a point called Vildmansnass, by St. Egede, the venerable apostle of the Greenlanders. In his time, 1721—1736, it was inhabited by several Greenland families, whose winter dwelling remains desolate and in ruins, the firth flowing into the house at high tide. Dr. Pingel says, that no aboriginal Greenlander builds his house so near the water's edge. The points mentioned above, the writer of the letter had visited; but he adds, on the authority of a countryman of his own, highly deserving of credit, that at Napparsok, ten Danish miles (forty-five English) to the north of

* Philosophical Magazine, No. 50.

Ny-Sukkertop, (lat. 65° 20′ N.), the ruins of ancient Greenland winter-houses are to be seen at low water. Dr. Pingel is not aware of any instance of subsidence in the more northern districts; but he suspects that the phenomenon reaches at least as far as Disco Bay, or nearly to 69° north latitude.*

BLOCKS OR BOULDERS IN THE NORTH OF ENGLAND.

At the anniversary of the British Association, Professor Phillips gave an account of the distribution over the northern parts of England of Blocks or Boulders. The Association, he observed, had formerly proposed a question regarding this distribution, and the present was a partial attempt at its solution; and it was interesting both to the geologist and the geographer, as it involved the effects of running water in modifying the surface of a country. In glancing over the north of England, we find a great variety of rock formations, from the oldest slates to the newer tertiary; the country generally slopes to the east, with the exception of the group of Cumbrian mountains, which form a local conical zone. One striking feature in its physical geography, is an immense valley running north and south, and passing through a great variety of formations: the Wolds of York being chalk, the strata near Whitby of oolite, the vale of York new red sandstone, while the carboniferous rocks are displayed in Northumberland and Durham. All the country from the Tyne to the Humber is covered with transported boulders, many of which are of rocks quite different from any near the spots where they occur, and some even not recognisable as British rocks. Could Mr. Lyell's ideas regarding the office of icebergs be true, that they had been the means of transporting gravel to distant places? Boulders of the Shap Fell granite had been found in the south-eastern part of Yorkshire; in the interior, there were great accumulations of them in many places, their directions seemed all to converge to a certain point, in what is termed the Pennine chain, but on this chain no boulders have been observed, except at one point, from which you look towards Shap Fell; towards the north they have been drifted nearly as far as Carlisle, but there is no trace of them towards the west. We also find boulders from Carrick Fell carried to Newcastle and the Yorkshire coast, and these have been drifted over the same point of Stainmoor. Mr. Phillips gave several conflicting opinions of different geologists, to account for this extraordinary transportation: the bursting of the banks of lakes; the alternate elevation and depression of mountain chains; and the supposition that the entire country had been under the sea, when the distribution of boulders had taken place.—Mr. Sedgwick then rose, and remarked, that the direction of transport of the blocks may have been modified by the surface over which they were carried; and that Sir James Hall had been the first who had observed the Shap Fell boulders. These boulders Mr. Sedgwick had noticed on the shores of the Solway Firth, mixed with gravel from Dumfries-shire. He alluded to the action of water upon the crests of mountains, and to the occurrence of transported blocks at considerable elevations. It was well known that mountain lakes were gradually filling up: and he had shown in a paper to the Geological Society the relation of a lake to the age of the valley containing it. With the diluvial gravel over the country we find associated organic remains,

* Jameson's Journal, No. 42.

—a strong proof that the land must have been dry when the transportation took place.—Mr. Murchison had observed these boulders associated with recent shells at various elevations,—consequently the land must have been at one time under the sea, and have been subsequently elevated. There must have been a relative change of the level of land and sea; and Professor Esmark, in Norway, had been the originator of the idea of the icebergs transporting gravel. He referred to the valley of the Inn, in the Tyrolese Alps, as illustrating this alteration of level:, boulders of granite had been found on calcareous mountains composing one of its sides, elevated five or six thousand feet above the sea level: and this valley could not have been scooped out.—Dr. Buckland was of opinion that the land must have been dry before the action of the water that had transported these blocks. There was a great number of organic remains mixed with the gravel, derived from animals existing on dry land; and this was not only true in England, but confirmed by observations made on the continent of Europe.*

DISENGAGEMENT OF INFLAMMABLE GAS IN THE INTERIOR OF COAL MINES.

MONSIEUR COMBES has presented a notice to the Royal Academy of Sciences at Paris, which may serve as a sequel to the remarks of Mr. Buddle, an English engineer, upon the evolution of hydrogen gas in coal mines. It seems quite certain, as stated in this notice, that the evolution of carburetted hydrogen in coal-mines, has frequently a relation to the pressure exercised externally at the surface, so that there is no disengagement where the external pressure is considerable, and it becomes more and more abundant in proportion as this pressure is diminished. Besides, the pressure under which the gas commences to be evolved from the pores of the coal, varies in different mines. It is sometimes scarcely superior to the common pressure of the atmosphere, as without doubt is the case in many of the mines in Northumberland, in which, according to Mr. Buddle, the atmosphere becomes explosive when the barometer is low, whilst scarcely a trace of inflammable air is to be found when the barometer is very high. At other times, it exceeds considerably the pressure of the atmosphere. Monsieur Combes states the following as a proof of this. We give the statement in his own words. "In the year 1830, I caused the shaft of a coal-pit at Latour, near Firmini, Department of the Loire, to be emptied of the water it contained. This pit had for many years been abandoned, on account of the immense quantities of inflammable air which had been generated in the galleries, which had occasioned so many deplorable accidents, that the working could not be continued, on account of the imminent risk. The pit was 230 feet deep at the place where it reached the roof of the galleries in the coal, and it was filled with water to within 65 feet of the surface. This free portion of the pit contained only atmospheric air, without a single trace of carburetted hydrogen. When the water was pumped out to the depth of 193 feet from the surface, the roof of the galleries being still covered with water to the extent of 37 feet, the gas began to be disengaged through the column of water still in the pit, with a noise such as a copious spring would have made by

* Jameson's Journal, No. 42.

falling from the upper part of the shaft. After this event, the air in the pit continued to be in the highest degree explosive. One day two workmen incautiously descended into the pit to discover the spring, which they supposed issued from the upper part of the shaft; they took a common lamp along with them, and when they had descended about 45 feet, their lamp set fire to the gas; when, fortunately enough, only the upper layer exploded. One of the workmen was severely scorched. When they had ascended to the surface, and a wisp of burning straw was thrown into the pit, a very great explosion was the immediate result. Thus, in this mine, the inflammable gas was evolved under a pressure at least equal to two atmospheres, and probably much more; the shaft was in fact opened upon the most elevated portion of the workings, and all the galleries communicating with it had a rapid descent, following the inclination of the bed, which was at an angle of 18° or 20°. The escape of the gas through this depth of water continued without interruption, with the same intensity, during several months. I may add, that, after I had caused a horizontal floor of planks of fir to be constructed, and covered over with about six feet of stiff clay, well pressed down, and sunk to the bottom of the shaft, the gas escaped much more sparingly across the fissures of schistous rock, but still in very considerable quantities. In those beds which retain the hydrogen only under such great pressure, it is manifest that the quantity will vary to a very trifling extent, with the variations of the barometer. Nevertheless, in certain circumstances, the air in the mine is more charged with gas, as during the time of a storm, when the barometer is low, than in calm and fine weather, with a dense atmosphere." In the work to which this notice is, as we have said, a kind of supplement, Mr. Buddle, when treating of the explosion which took place on the 3rd of August, 1830, in the coal-mine of Jarrow, points out two causes which are the cause of explosions in the coal-mines in the north of England; 1st, The numerous fissures and rents in the encasing rock, which thus form cavities filled with gas, whence it issues in greater or less quantities, according as the pressure of the atmosphere is more or less; 2dly, Blind cavities in the coal-seam itself, or in the surrounding rock, whence the gas suddenly escapes, when the galleries reach and open them up. M. Combes confirms the existence of this second cause of disengagement, from the occurrence of accidents which have happened in French mines; and, among others, by an explosion which happened on the 10th of April, 1824, in the coal-mine of Ronchamp, in Haute-Saone, when twenty miners were killed, and sixteen most severely injured. According to the reports of the engineers of the mine, inflammable gas had previously very rarely, and in very small quantities, manifested itself in this mine. A trifling disengagement had taken place in a try-work which was begun at the bottom of the pit of St. Louis, close to a fault. In a report which M. Thirra gave in to the Director-General of bridges, roads, and mines, he remarks, "It was imagined that the gas might be got rid of by means of a ventilator, which should propel it into a gallery of transport, in which the current of air was so strong, that it sometimes blew out the lamps of the workmen. The engineers supposed that the gas, instead of having been forced out of the mine by the current of air, was forced only into some old abandoned workings which were situated at the extremity of the gallery of transport, behind pillars and walls, and some rubbish; and that it was there ignited, owing to the falling down

of a part of the roof of this cavity, whereby a great quantity of the gas was suddenly expelled, or possibly owing to some of the workmen having taken a lamp into it. However this may be, the gas has begun to show itself in the works, in the neighbourhood of the fault of the pits of St. Louis; and this circumstance recurring frequently in the mines, it becomes important to recommend it to the peculiar attention of miners, and to point out to them the means of its prevention.*

PROGRESSIVE RISE OF A PORTION OF THE BOTTOM OF THE MEDITERRANEAN.

M. Theodore Virlet lately addressed a note to the French Academy of Sciences, in which he directed the attention of geologists to the probability of the speedy appearance of a new island in the Grecian Archipelago, in consequence of the progressive rise of a sunken solid rock (composed of trachytic obsidian?) in the gulf of the volcano of Santorini The following are the author's observations on this subject:—" Towards the end of the last century, at the period when Olivier visited Santorin, the fishermen of the island asserted that the bottom of the sea had recently risen considerably between the island of Little Kaiméni and the Port of Thera; in fact the soundings did not give a greater depth than fifteen to twenty fathoms, where formerly the bottom could not be reached. When Colonel Bory and the author visited the island in 1829, they were able not only to confirm the truth of Olivier's statement, but also to ascertain, by various soundings, that the rise of the submarine land had continued, and that at the point indicated the depth was not more than four fathoms and a-half. In 1830 the same observers made new soundings, which enabled them to determine the form and extent of the mass of rock, which in less than a year had been elevated half a fathom. It was found to extend 800 metres from east to west, and 500 from north to south. The submarine surface augmented gradually to the north and west, from four to twenty-nine fathoms, while to the east and south this augmentation amounted to forty-five fathoms. Beyond this limit the soundings indicated in all directions a very great depth. I have lately been informed that Admiral Lalande, who, since 1830, has twice returned to Santorin, ascertained that the rock still continues to rise; and that, in September 1835, the date of his last visit, the depth of water amounted to only two fathoms, so that a sunken reef now exists which it is dangerous for brigs to approach. If the rock continues to rise at the same rate, it may be calculated that, in 1840, it will form a new island, without, however, those catastrophes which this phenomenon seems to presage for the gulf of Santorin, being a necessary consequence of the epoch of its appearance at the surface of the water. Since the eruptions of 1707 and 1712, which produced the new Kaïméni, volcanic phenomena have completely ceased in the gulf of Santorin, and the volcano seems at the present day quite extinct. Nevertheless, the rise of a portion of its surface seems to demonstrate continual efforts to make an eruption during fifty years; and that, whenever the resistance shall not be strong enough to offer a sufficient obstacle, the volcano will again resume its activity."†

* Jameson's Journal, No. 41.

† Jameson's Journal, No. 41.

LIAS FORMATION IN AFRICA.

On May 25, a notice was read to the Geological Society, on the supposed existence of the Lias formation in Africa, by Roderick Impey Murchison, Esq., F.G.S. Mr. Leach, of Milford Haven, a short time since presented to the Society some organic remains, stated to have been obtained by Commodore Sir Charles Bullen on the west coast of Africa. As these organic remains agree exactly with fossils of common occurrence at Lyme Regis, it was conjectured that some mistake might have occured respecting them; but Mr. Leach has been subsequently informed by Sir Charles Bullen that they were collected by himself and officers at West Bay, Fernando Po, Accra, and Sierra Leone, and that they occur in abundance. Mr. Murchison also announced in this notice, that Sir John Herschel has discovered Trilobites in a rock which occurs to the north of the Cape of Good Hope.*

PHENOMENA OF METALLIFEROUS VEINS.

On Nov. 10, at the Penzance Institution, Mr. W. J. Henwood, F. G. S. delivered an interesting lecture upon the Phenomena of Metalliferous Veins, which he closed as follows.

The facts and observations which I have thus attempted to bring together lead me to conclude :—

1. That the phenomena of our metalliferous districts are not consistent with the idea of the veins having originated in fissures.

2. That the appearances and positions of the *horses* do not countenance the assumption of their having ever supported the bounding planes of *empty spaces*.

3. That the contents of veins varying in different rocks is inconsistent with any theory of their having been filled from *above*, or by *injection*, or *sublimation* from *beneath*.

4. That the metallic contents of parallel veins in the same district being similar in different rocks; and also in veins in different districts not far apart, at right angles to each other, is irreconcilable with their being filled at the same period by electric agency.

5. That we have no *experimental* knowledge that rocks now are, or ever were, in opposite electrical states; our real knowledge extending to the existence of electric currents in the present *metalliferous* contents of veins, in their present places *only*.

6. That the *heaves* and *slides* are inexplicable on any yet assumed direction of mechanical disturbance, which is consistent with the general simplicity of natural causes; and that synchronous fissures exhibiting these phenomena are irreconcilable unless of contemporaneous origin with the containing mass.

7. That there is no line of distinctions to be drawn between the intersections of small veins found in hand specimens—and the larger ones occurring in what have been called *true veins*, *contemporaneous* veins, and *veins of segregation*.

8. That the only theory yet propounded which agrees with the phenomena is that of *segregation*, and that so far only as it admits the contemporaneity of the veins and their disturbances with the rocks in which they occur.

* Philosophical Magazine, No. 57.

In submitting the foregoing views, I feel I am only exhibiting the opinions which *practical* men in this country have long generally entertained; and I shall be more than amply recompensed for some years of labour I have bestowed on the subject, if I shall succeed in inducing but *one* of them to record the results of his daily experience for the benefit of his successors.*†

A NOTICE OF TWO HITHERTO UNDESCRIBED SPECIES OF RADIARIA, FROM THE MARLSTONE OF YORKSHIRE; AND REMARKS ON THE ORGANIC REMAINS IN THAT STRATUM.

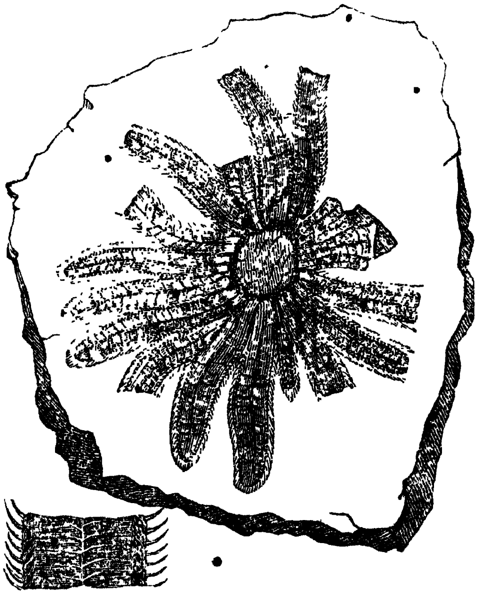
By Mr. W. C. Williamson, Curator to the Manchester Natural History Society.

THE occurrence of remains of Radiaria in the marlstone of Yorkshire has been for sometime known by the collectors of fossils on that coast; but they have chiefly consisted, until lately, of Ophiura Milleri Phillips. A little time ago, there were found traces, of an imperfect nature, of what was apparently a true Asterias, with five rays; only, however, showing the lateral papillæ of the rays, which were sufficiently distinct to prove its being different from Ophiura. The occurrence of true Asteriæ, however, was decided by the discovery of the fossil now figured, which was found in the marlstone at the point where it is carried up into the cliff, to the north of the great fault, at the Peak Hill, near Robin Hood's Bay (see Phillips's *Geoglogy of Yorkshire*), near the lower part of the stratum, where it blends with the lower lias. The figure represents the object reduced to one third of the real size. The slab on which the fossil is preserved is of a rather micaceous nature, a matrix generally unfavourable to preserving minute characters; and a portion of the fossil having adhered to the upper part of the rock, which fell in pieces, the view presented is rather that of the internal than the external structure of the animal. The central circle, the situation of the mouth, is preserved very distinctly; and, proceeding with considerable regularity from this, is a series of rays 20 in number. Those rays near their base bear the sulcus (furrow) which runs under those of recent Asteriæ; but towards their apex they become more worn and thin, showing, in several places, a small wiry line, with short ribs branching off at right angles, apparently a species of appendage, resembling what represents the vertebral column and ribs in the turtle, and which is observable in recent Asteriæ. There are also slight traces of transverse grooves on the whole surface of each ray; but these are generally almost obliterated. Along the margins are extremely regular rows of small rhomboidal perforations, or *cells*, from which proceed a series of lateral filaments, or delicate lengthened papillæ, but on the surface of the fossil it merely presenting to us the interior, no papillæ are preserved. The apex of such rays as have not been broken off prior

* Professor Jameson, in March 1808, read a paper on contemporaneous veins before the Wernerian Society, which was published in the first volume of the Society's Memoirs; afterwards, in 1818, a memoir on the same subject, printed in second volume of the Wernerian Memoirs; and we understand papers on the contemporaneous origin of many veins, by Professor Jameson, have appeared in the Annals of Philosophy and elsewhere.

† Jameson's Journal, No. 43.

to the animal's being entombed are obtusely pointed. Having met with no species with which this corresponds, I will venture, as one more slight tribute to the high scientific character of R. I. Murchison, Esq., to call it Asterias Murchisoni.



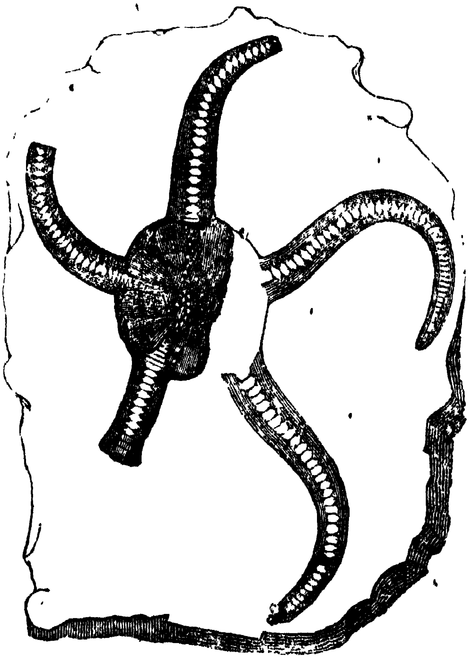
(Fossil Radiaria : Asterias Murchisoni.)

The second figure represents a species of Ophiura, [reduced to one third of the real size,] from the same stratum; but not so low in the series, and found at Staithes, a few miles further to the north. It bears some resemblance to Ophiura Milleri, but differs in two or three particulars. The base of each ray has been protected by two strong heart shaped plates, the spaces between which would seem to have been rather flexible, but protected by small orbicular scales, or plates, which are, however, rather indistinct. The most evident distinction is in the arrangement of the plates of the rays: as in O. Milleri, we have here three rows; but, instead of the dorsal row being, as in that species, of double the width of the lateral ones, the reverse is the case; forming a character at once evident and distinct.

To this species I have given the name of Ophiura.

The marlstone on the Yorkshire coast generally averages in thickness about 130 ft. Its ordinary appearance is that of a series of shales and

beds of lameller sandstone, in some parts divided by layers of ironstone of various thicknesses. These occur chiefly in the first 30 ft. from the upper alum shale, and the division from which is marked by a band of irony nodules, so cemented together as to form a solid stratum, about 6 in. in thickness. This seam, as far as I have been able to discover, contains no fossils, except Ammonites Hawskerensis, and a species of



(Fossil Radiaria: Ophiura.)

small Trochus. Below this, the ironstones are divided for the space of about 12 ft., with dark shales, filled with a profusion of fossils, of which the following appear the most important:—Belemnites conicus, B. compressus, Pecten æquivalvis, P. sublævis, Avicula inæquivalvis, A. cygnipes, Plicatula spinosa, Ostreæ. These fossils I have found most abundant below the signal cliff at Staithes, where the shales are better exposed than elsewhere.*

ARTIFICIAL SUBSTANCE RESEMBLING SHELL.

On February 25, 1836, a paper was read before the Royal Society, "On an artificial Substance resembling Shell; by Leonard Horner, Esq.,

* Magazine of Natural History, No. 64.

F.R.S. L. and Ed.: with an account of the examination of the same; by Sir David Brewster, K.H., LL.D., F.R.S., &c."

The author, having noticed a singular incrustation on both the internal and external surfaces of a wooden dash-wheel, used in bleaching, at the Cotton Factory of Messrs. J. Finlay and Co., at Catrine, in Ayrshire, instituted a minute examination of the properties and composition of this new substance. He describes it as being compact in its texture, of a brown colour, and highly polished surface, with a metallic lustre, and presenting in some parts a beautiful iridescent appearance: when broken it exhibits a foliated structure. Its obvious resemblance, in all these respects, to many kinds of shell, led the author to inquire into its intimate mechanical structure, and into the circumstances of its formation. He found, by chemical analysis, that it was composed of precisely the same ingredients as shell; namely, carbonate of lime and animal matter. The presence of the former was easily accounted for; as the cotton cloths which are placed in the compartments of the wheel, in order that they may be thoroughly cleansed by being dashed against its sides, during its rapid revolutions, have been previously steeped and boiled in lime water. But it was more difficult to ascertain the source of the animal matter; this, however, was at length traced to the small portion of glue, which, in the factory where the cloth had been manufactured, was employed as an ingredient in forming the paste, or dressing, used to smooth and stiffen the warp before it is put into the loom. These two materials, namely lime and gelatine, being present in the water in a state of extreme division are deposited very slowly by evaporation; and thus compose a substance which has a remarkable analogy to shell, not only in external appearance, and even pearly lustre, but also in its internal foliated structure, and which likewise exhibits the same optical properties with respect to double refraction and polarizing powers.

A letter from Sir David Brewster, to whom the author had submitted for examination various specimens of this new substance, is subjoined; giving an account of the results of his investigations of its mechanical and optical properties. He found that it is composed of laminæ, which are sometimes separated by vacant spaces, and at others, only slightly coherent; though generally adhering to each other with a force greater than that of the laminæ of sulphate of lime, or of mica; but less than those of calcareous spar. When the adhering plates are separated, the internal surfaces are sometimes colourless, especially when these surfaces are corrugated or uneven; but they are almost always covered with an iridescent film of the most brilliant and generally uniform tint, which exhibits all the variety of colours displayed by thin plates or polarizing laminæ. This substance, like most crystallized bodies, possesses the property of refracting light doubly; and, as in agate and mother-of-pearl, one of the two images is perfectly distinct, while the other contains a considerable portion of nebulous light, varying with the thickness of the plate, and the inclination of the refracted ray. Like calcareous spar, it has one axis of double refraction, which is negative; and it gives, by polarized light, a beautiful system of coloured rings. It belongs to the rhombohedral system, and, as in the *Chaux carbonatée basée* of Haüy, the axis of the rhombohedron, or that of double refraction, is perpendicular to the surface of the thin plates. As mother-of-pearl has, like arragonite, two axes of double refraction; this new substance may be regarded as having the same optical relation to calcareous spar that mother-of-pearl has to arragonite.

The flame of a candle, viewed through a plate of this substance, presents two kinds of images: the one bright and distinct, the other faint and nebulous, and having curvatures, which vary as the inclination of the plate is changed: the two kinds being constituted by oppositely polarized pencils of light. On investigating the cause of these phenomena, Sir David Brewster discovered it to be the imperfect crystallization of the substance; whence the doubly refracting force separates the incident light into two oppositely polarized pencils, which are not perfectly equal and similar. In this respect, indeed, it resembles agate, mother-of-pearl, and some other substances; but it differs from all other bodies in possessing the extraordinary system of composit crystallization, in which an infinite number of crystals are disseminated equally in every possible azimuth, through a large crystalline plate; having their axes all inclined at the same angle to that of the larger plate, and producing similar phenomena in every direction, and through every portion of the plate; or this remarkable structure may be otherwise described, by saying that the minute elementary crystals form the surfaces of an infinite number of cones, whose axes pass perpendicularly through every part of the larger plate.

An examination of the phenomena of iridescence afforded by this new substance, leads him to the conclusion that the iridescent films are formed at those times when the dash-wheel is at rest, during the night, and that they differ in their nature from the rest of the substance. These phenomena illustrate in a striking manner some analogous appearances of incommunicable colours presented by mother-of-pearl, which had hitherto baffled all previous attempts to explain them; but which now appear to be produced by occasional intermissions in the process by which the material of the shell is secreted and deposited in the progress of its formation.*

OLD SLATE-ROCKS OF DEVON.

At the anniversary of the British Association, in the Section C of Geology, there was read a paper "On the old Slate-Rocks and Culm-Deposits of Devonshire," by Professor Sedgwick, and R. J. Murchison, Esq., V.P.R S., &c.

Mr. Murchison began by observing, that he was about to submit a mere outline of a more detailed memoir on the Physical structure of Devonshire, which, in conjunction with Mr. Sedgwick, he purposed to lay before the Geological Society of London. One object they had in view was, to remedy the defects in existing geological maps, as to colouring subdivisions of formations, and another to ascertain by actual Sections the true position of successive deposits, and their natural subdivisions, so as to bring them into comparison with other corresponding deposits, and to determine their true place in the succession of British formations. By help of a Section the following succession of deposits in the ascending order was determined:—

1. A system of slaty rocks, containing a vast abundance of organic remains, generally in the form of casts; these rocks sometimes pass into a fine glossy clay-slate, with a true transverse cleavage—sometimes into a hard quartzo-flagstone, not usually of a reddish tinge, sometimes into a

* Philosophical Magazine, No. 50. This interesting paper, would have been more appropriately placed in the Chemical Section of the present volume.

reddish sandstone, subordinate to which are bands of incoherent shale; in North Devon they are very seldom so calcareous as to be burnt for lime, but in South Devon, rocks of the same age appear to be much more calcareous. This series is finely exposed in the Valley of Rocks, and the Valley of the Lynn, but its base is no where visible in this line of section.

2. A series of rocks, characterized by great masses of hard thick-bedded red sandstone and red flagstone, subordinate to which are bands of red, purple, and variegated shales; the red colour occasionally disappears, and the formation puts on the ordinary appearance of a coarse siliceous graywacke, subordinate to which are some bands of slate, but too imperfect to be used for roofing. This system contains very fine organic remains; it is several thousand feet in thickness, occupying the whole coast from the west end of the Valley of Rocks to Combmartin, being thrown back by a dip into the cliffs between Porlock bay and Linton; it reappears in North Hill and the Quantock Hills.

3. The calcareous slates of Combmartin and Ilfracombe, of very great aggregate thickness, abounding in organic remains, and containing in a part of its range at least nine distinct ribs of limestone, burnt for use. This limestone is prolonged into Somersetshire, and is apparently the equivalent of the limestone on the flank of the Quantock Hills.

4. A formation of lead-coloured roofing-slate, of great thickness, and occupying a well-defined zone in North Devon, its upper bed alternating with, and gradually passing into, a great deposit of green, gray, and purple, or red sandstone, and sienaceous flagstone. These siliceous masses alternate with incoherent slates, and are in some places surmounted by great masses of red unctuous shale, which, when in a more solid form, generally exhibit a cleavage oblique to the stratification.

5. The Silurian System, resting conformably on the preceding, of great thickness, on the western coast of North Devon, occupying a zone several miles wide, and containing many subordinate beds and masses of limestone. In its range towards the eastern part of the county it gradually thins off, but its characters are well preserved, and throughout it contains an incredible number of characteristic organic remains.

6. The carbonaceous system of Devonshire. This system is very greatly expanded, stretching in a direction east and west across the county, occupying the whole coast from the neighbourhood of Barnstaple to St. Gennis, in Cornwall, and on its southern boundary ranging so close to Dartmoor, that its lower beds have been tilted up and mineralized by the action of the granite. This great formation is therefore deposited in a trough, the northern border of which rests partly in a conformable position upon the Silurian system, and partly upon older rocks, partly of the division No. 4. Its southern border rests on the slate-rocks of Cornwall and Launceston, and on the north flank of Dartmoor. From one side to the other it exhibits an extraordinary succession of violent contortions, but its true place in the ascending section admits of no doubt whatever. In some places it is overlaid by patches of green sand, and in one part of the coast, west of Bideford, it is overlaid by the conglomerates of the new red sandstone, which are seen for half a mile resting unconformably on its edge. The lowest portion of this vast deposit is generally thin-bedded, sometimes composed of sandstone and slate, with impressions of plants,—sometimes of indurated compact slate, both in an earthy and crystalline state. These beds are surmounted by alternations of shale and dark-co-

loured limestone with a few fossils; subordinate to these on the west side, are many thin veins and flakes of culm and anthracite.

On the eastern side of the county the coal is wanting, and the calcareous beds are much more expanded. On the south side of the great trough the calcareous bands and dark shales are well exhibited; but near Oakhampton are, as above stated, mineralized by the action of the granite. The higher beds of this deposit are well exhibited on the coast west of Bideford, and consist of innumerable alternations of ferruginous sandstone, flagstone, and shale, containing, in several places, concretions of ironstone, very often exhibiting impressions of plants; and one extended tract of country, containing at least three beds of culm or stone-coal, associated with shales, contains many plants of species not known in the true coal-measures. Though in a state of greater induration than the ordinary coal-measures of England, and in most parts almost destitute of any trace of coal, yet even in these respects it differs not from a great unproductive tract of the coal field of Pembrokeshire. Therefore from the order of super-position, from the mineral structure, from the absence of that slaty cleavage which characterizes the older rocks, on which the deposit rests, and from the specific character of its organic remains, they classed it with the carboniferous series.*

OBSERVATIONS REGARDING FOSSIL INFUSORIA, COMMUNICATED TO THE ROYAL ACADEMY OF SCIENCES OF BERLIN.

By Professor Ehrenberg, on the 27th and 30th of June, 1836.†

THE proprietor of the porcelain manufactory at Pirkenhammer, near Carlsbad, observed that the substance occurring in the peat-bog, near Franzensbad, in Bohemia, and resembling the Kieselguhr (a siliceous deposit), "is almost entirely composed of the coverings of some species of *navicula*, and seems to be the product of the action of subterranean heat on the ancient submarine land." Mr. Fischer accompanied this notice with a specimen 2 inches long, 1 inch broad, and ¾ of an inch high, of the siliceous mass, together with some specimens of the peat, requesting me to determine the animal form, and to publish the result. A microscopic investigation has confirmed the discovery of Mr. Fischer; the Kieselguhr of Franzensbad is almost entirely composed of extremely well preserved *naviculæ*, with which are also mixed some other Bacillariæ; and the great transparency, together with the purity from organic matter, of all the siliceous shields, render it probable that they have been purified and heaped together by an unusual degree of heat. It is not probable that they belonged to the bottom of the sea, for the great majority of the forms, as well according to the numerical relations as the striping, are identical with the *Navicula viridis*, a species found so abundantly in all the fresh water near Berlin. *Naviculæ* can also be recognised in the specimens of the turf; and although for the most part different from those of the *Kieselguhr*, have nevertheless the forms of living species. An examination of original specimens of the *Kieselguhr* from the Isle of France and Santa Fiora, in Tuscany, similar to those analyzed by Klaproth, has shown, that they also consist almost exclusively of the shells

* Magazine of Popular Science, No. 8.

† From Wiegmann's Archiv fur Naturgeschichte, Zweiter Jahrgang. Viertes Heft. 1836.

of infusory animals of several genera of Bacillariæ, chiefly of species still living, and also of a few siliceous spicula of sea and fresh water sponges; but without any uniting basis. Thus the discovery of Kutzing, that the coverings of Bacillariæ consist of silica, receives new confirmation.

Several years ago, the author discovered that the ochre-yellow slimy substance, which sometimes covers the soil in marshy rivulets and ditches, and seems often to be regarded as a deposition of oxide of iron, is a very delicate form of the Bacillariæ, which, when heated, becomes red, like the oxide of iron, and is very ferruginous; but which neither loses its form by ignition, nor by the action of acids, and therefore must possess a siliceous covering, that approaches most nearly the genus *Gaillonella.* Hence, this form was, during the previous year, figured as the *Gaillonella ferruginea* in plate 10 of the work on Infusoria, which is about to appear. All the ochre surrounding bog iron ore exhibits siliceous filiform members, as the residue after the removal of the iron. The above appearances render it extremely probable that the Gaillonella ferruginea performs a very important part in the formation of bog iron ore, whether it be by the direct addition of the iron contained in itself, or by attracting that belonging to neighbouring foreign substances. The species of fossil infusory animals occurring in the above mentioned substances, are the following:—

1. In the *Kieselguhr* of Franzensbad:—1. *Navicula viridis*, as the principal mass: of various dimensions, the largest being 1·9‴; 2. *Navicula gibba*; 3. *Navicula fulva*; 4. *Navicula Librile*; 5. *Navicula striatula*; 6. *Navicula viridula.* (The two last belong to salt water; all the others to fresh water). 7. *Gomphonema paradoxum*; 8. *Gomphonema clavatum*; 9. *Gaillonella varians?* all fresh water animals. None of these can be distinguished from the recent species.

2. In the peat-bog of Franzensbad:—1. *Navicula granulata*, the most abundant, and hitherto an unknown form; 2. *Navicula viridis*, rare; 3. *Bacillaria vulgaris?* 4. *Gomphonema paradoxum*; 5. *Cocconeis undulata*, all living forms; the last in the salt water of the East Sea.

3. In the *Bergmehl* of Santa Fiora:—1. *Synedra capitata*, a new species forming the principal mass; 2. *Synedra ulna*; 3. *Navicula Librile*; 4. *Navicula gibba*; 5. *Navicula viridis*; 6. *Navicula capitata*; 7. *Navicula zebra*; 8. *Navicula phœnicenteron*; 9. *Navicula inæqualis*, all identical with living fresh water species; 10. *Navicula viridula*, a living salt water species; 11. *Navicula granulata*; 12. *Navicula follis*, both new species; 13. *Gomphonema clavatum*; 14. *Gomphonema paradoxum*; 15. *Gomphonema acuminatum*, all species living in fresh water at the present day; 16. *Cocconema cymbiforme*, identical with the recent fresh water species; 17. *Cocconeis undulata*, a recent marine species; 18. *Gaillonella italica*, n. sp. 19. Siliceous spicula of a *Spongia* or *Spongilla.*

4. Klaproth's *Kieselguhr* of the Isle of France contains, 1. *Bacillaria vulgaris?* as the principal mass; this species occurs in a recent state in all our seas; 2. *Bacillaria major*, a new species; 3. *Navicula gibba*, a recent species living both in fresh and in salt water; 4. *Navicula*, species not determined; 5. *Navicula bifrons.* None of these organic beings are so well preserved as the species occurring in the other mineral substances, and seem, with exception of the last, to be marine species.

The great majority of these fossil infusory animals still live; and most of them occur near Berlin, and on the East Sea near Wismar. Most of them are so well preserved, that they can be minutely investigated. Thus, besides the numerous ribs, we can recognise the six openings of the hard

coverings of the *Navicula viridis;* the four openings of the *Gaillonella;* the two openings of the *Gomphonema,* &c. It is only the rock from the Isle of France, that seems to contain a preponderating number of marine animals. We are entitled to suppose that the few new forms are undiscovered living species.

The great predominance of particular species is extremely remarkable. Thus the *Navicula viridis* characterizes by its extreme abundance the *Kieselguhr* of Franzensbad; the *Bacillaria vulgaris* that of the Isle of France; and the *Synedra capitata* the *Bergmehl* of Santa Fiora. The recent species are more mixed, and live only around and on the vegetables by which they are nourished.

The slaty Tripoli of commerce also consists almost entirely of infusory animals. The polishing slate of Bilin, in Bohemia, which forms whole strata, consists almost entirely of a minute infusory animal, which can be referred to the genus *Gaillonella* (*Gaillonella distans*). The *Podosphenia nana.* n. sp., *Navicula scalprum?* and *Bacillaria vulgaris* (the two last are recent marine species) occur singly between the individuals of the prevailing species, and the first only can sometimes be compared to the Gaillonella for abundance. In the same polishing slate there occur impressions of plants and one species of fish, the *Leuciscus papyraceus* of Bronn, according to Agassiz. In the adhesive slate of Menilmontant, some indistinct traces were found of the *Gaillonella distans.* An individual of this animal, which, almost without any uniting basis, constitutes the polishing slate of Bilin, is 1·288 of a line in size; many are smaller; there are consequently forty-one thousand millions of these animals in one cubic inch of that substance.*

VAN DIEMAN'S LAND.

On May 25, a paper was read to the Geological Society, entitled "A Notice on Maria Island, on the east coast of Van Dieman's Land, (S. lat. 42° 44′ E., long. 148° 8′,) by George Frankland, Esq., Surveyor-General of the Colony. Maria Island is composed, for the greater part, of trap; but strata of freestone well calculated for building purposes frequently occur, and at the northern point of the island is a perpendicular cliff from 200 to 500 feet high, composed of dark grey limestone, formed of oysters, muscles, and other shells, in a state of great preservation. On the eastern coast, near Cape Mistaken, are numerous caverns, some at the height of 600 feet above the level of the sea, the roofs of which are studded with stalactites. Mr. Frankland states that Van Diemen's Land in every part furnishes strong evidence of the ocean having once occupied a much higher level than at present. The paper also contains much valuable information respecting the natural productions of the island.†

ON BORED WELLS.

This convenient, we may say elegant, method of obtaining good water from great depths, without the labour of lifting it, is spreading extensively in France, principally owing to the enlightened and patriotic exertions of MM. Arago and Hericart de Thury. The first, by his writings

* Jameson's Journal, No. 43.

† Philosophical Magazine, No. 57.

on the subject, and his successive notices of the works as they are executed, excites and keeps alive the attention of the whole French nation.

For the same purpose, with regard to our own country, we shall, at all times, be gratified by receiving and publishing, correct and detailed accounts of Bored Wells, executed in England, &c. Cases of supposed failure in these attempts, where all the circumstances are known, would be as acceptable as those of success. Hints might be suggested for proceeding again with a prospect of arriving at the desired object; or, if this is hopeless, the facts might be recorded and useless expenditure prevented in future similar cases. In preparing the accounts, attention should always be paid to the kind of strata passed through, their thickness, &c. The locality of the well should be accurately described, its contiguity to river, mountain, sea, lake, &c., or the contrary. The waters of infiltration, (land-springs, &c.,) should be noted; and the supply, qualities, temperature, and permanent elevation of the water finally obtained, should be very carefully observed and described.

Among the more recent instances of success in well-boring in France, is one not far from the bank of a river, in a meadow belonging to the Château de Cangé, about three miles from Tours. The water was found at 425 feet deep, and the supply is about 560 imperial gallons per minute. At Elbeuf, two wells, contiguous to each other and to the river Seine, have been bored to nearly 500 feet. They are remarkable for the volume, purity, and high temperature (61° Fahr.) of their waters. In twenty-four hours after a storm, or violent rain, one of these wells becomes troubled, and its water issues turbid with clay or sand, precisely like that of the Seine after heavy rains. As the bore of this well proceeded, several lots of very minute eels floated out from it: many of them were caught alive and sent to Paris. A M. Dieu has lately announced to the French academy, that he is occupied in endeavouring to use steam-power as an agent in this art.

In a well lately bored in one of the abattoirs (public slaughter-houses) of Paris, the depths and thicknesses of the strata were carefully noted; and M. Arago himself examined the temperature of the water obtained: at 815 feet deep, he found it to be 68½° Fahr. The engineer was prepared to have gone down to 1,300 feet, but having pierced through the bed of chalk under which was found the water at Elbeuf, he desisted at the depth of 815 feet. From this depth the water rose to within 16½ feet of the surface.

If now we look on the other side of the picture, and regard the failures in France, we shall find a case the most remarkable for the extent of area over which unsuccessful attempts have been made, in the valley of the Garonne. From Toulouse to Bordeaux little hope is now entertained of profiting by wells of this kind. At Toulouse, the bore was carried down about 780 feet, being 282 feet below the level of the Mediterranean, and abandoned after a cost of above 1,100*l*. At Agen, at the depth of 400 feet, a series of calcareous earths, &c., similar to what had already been passed, again commenced, and the undertaker gave it up in despair. In Bordeaux, they bored through strata, &c., very like what had been met with at Toulouse, and not having met with water at 670 feet, it was deemed useless to proceed. Four other bores in the neighbouring department of La Gironde, were also unsuccessful; in one only did water appear. These repeated failures have naturally indisposed the inhabitants of this quarter of France to further attempts. A considerable addition to the geological knowledge of this part of the

kingdom has, however, been obtained; and among the facts collected by M. Boisgeraud, there is one result relating to the temperature of the earth, from 30 feet below the surface down to 340 feet, which deserves to be recorded. The mean of seven observations, each of twenty-four hours' duration, was found to be $2\frac{3}{4}°$ Fahr. for each 100 feet of depth: an increase which accords with that which is generally admitted.

The first bored well executed in the empire of Russia, was recently and successfully completed at Riga.*

TOOTH OF A MASTODON.

On May 24, a letter was read to the Geological Society, from Robert Fitch, Esq., of Norwich, to Edward Charlesworth, Esq., F.G.S., on the discovery of a Tooth of a Mastodon in the crag at Thorpe, near Norwich.

The pit in which the tooth was found is stated to present the following section:—

Top.—Alluvium	5 feet
Gravel	6
Brick-earth, sand, and gravel	14
Crag	5
Large chalk flints, mixed with crag shells, principally Pectens	
Chalk	

It was in the bed of large chalk flints that Mr. Fitch found the tooth; and he adds that Thorpe adjoins the parish of Whitlingham, in which Mr. William Smith discovered the tooth figured in his "Strata Identified."†

FOSSIL WOODS.

On June 8, a paper was read to the Geological Society, entitled, "Notice respecting a piece of Wood partly petrified by Carbonate of Lime; with some remarks on Fossil Woods, which it has suggested." By Charles Stokes, Esq., F. G. S.

Mr. Stokes lately received from Germany, with a collection of fossil woods, a piece of recent wood, stated to have been found in an ancient Roman aqueduct, in the principality of Lippe, in the Bückeberg, in which some parts are petrified by carbonate of lime, while the remainder of the wood, though in some degree decayed, is not at all mineralized. This fact has afforded an explanation of the peculiarities of some other instances of fossil wood, in which different parts of the specimen present different appearances. Two other instances are particularly described: one of silicified wood from Antigua, and one of a calcareous petrifaction from Allen Bank in Berwickshire. In both these cases it is inferred by the author, that the process of petrifaction commenced simultaneously at a number of separate points, and that it was suspended when only parts of the wood had been petrified. The unchanged parts would then be liable to decay; and in the specimen from Antigua, the process has been renewed after this remaining part

* Magazine of Popular Science, No. 1.
† Philosophical Magazine, No. 57.

had decayed in a considerable degree, when that also became silicified. In the calcareous petrifaction from Allen Bank, (which is described and figured by Mr. Witham, in his work on the structure of fossil vegetables), the parts which had not been petrified at the time the process was interrupted, have been entirely destroyed by the decay which then ensued, and the intermediate spaces have been filled up by the crystallization of carbonate of lime, without the removal of the petrified portions from the positions in which they grew, and in which they had become mineralized.

In the specimen from the Roman aqueduct the petrified portions run in separate columns through the wood, as if conducted downwards by the vessels or woody fibres. In that from Allen Bank the separate portions are spherical in form and independent of each other; and in that from Antigua they are independent, and though nearly spherical not regularly so. Hence the author infers that a different explanation must be sought for the manner in which the solution of mineral matter was supplied in the first instance from that of the two last.

The paper notices also the fossil wood from Lough Neagh and Bonn, in which some small parts preserve their texture, although remaining still unchanged in the midst of the petrified mass.

The author concludes with a short notice of the different conditions in which the structure of wood is preserved in different specimens, and considers that the condition of the wood has not any influence on the process of petrifaction.*

THE ICHTHYOSAURUS.

On June 8, a paper was read to the Geological Society, entitled, "Further notice on certain peculiarities of Structure in the Cervical Region of the Ichthyosaurus," by Sir Philip Grey Egerton, Bart., M.P., V.P.G.S. †

In a former communication Sir Philip Egerton gave an account of the cervical vertebræ of the Ichthyosaurus, and announced the discovery that the atlas and axis are firmly united and strengthened below by an accessory articulating bone. In this paper he shows, that the union of the two vertebræ is perfect at all periods of the animal's growth, and apparently in all the species of the genus hitherto discovered, having observed it in vertebræ varying in size from half an inch to seven inches and a half in diameter. Externally there is a strong line of demarcation between the two bones, but internally the cancelli appear to pass from one to the other. The atlas, independently of the union of the two vertebræ, is distinguished by the form of the anterior cavity for the reception of the basilar process of the occipital bone; by the outer margin being rounded instead of sharp, and by the triangular facet on the inferior part of the circumference for the reception of the accessory bone: the axis, independently also of its union with the atlas, differs from the other vertebræ, by the facet on the under surface for the reception of the accessory bone: and the third vertebra is also distinguished from the remaining bones of the neck by a facet for the articulation of a very small accessory bone. The intervertebal cavities of the 4th and 5th cervical vertebræ, the author states, are less than in the

* Philosophical Magazine, No. 57.

† For the preceding Notice, see *Arcana* for 1836, p. 263.

vertebræ of the dorsal and caudal regions, and the anterior cavity is considerably smoother than the posterior one of the same vertebræ.

Sir Philip Egerton states that the spinal column does not, as described by other authors, decrease in diameter from the middle dorsal vertebra to the atlas, but that the minimum diameter is attained about the fifth cervical vertebra, from which point to the occipital bone the increase in size is very rapid, the atlas being fully one fifth more in diameter than the above-mentioned bone.

In the former memoir Sir Philip Egerton described only one accessory bone in the cervical region of the Ichthyosaurus; but in this paper he proves that there are three, and proposes to designate them by the name of subvertebral wedge-bones. One of them is supplementary to the atlantal socket, another is common to the atlas and axis, and the third, which agrees in form with the second, but is much smaller, articulates on the under surface of the third vertebra.

The author, then, in conclusion, enlarges upon the admirable adaptation of the structure of the Ichthyosaurus to the habits of the animal.*

OBSERVATIONS ON SOME OF THE FOSSILS OF THE LONDON CLAY.

By Nathaniel Thomas Wetherell, Esq., F.G.S., M.R.C.S., &c.†

FROM the number of railroads now in progress in different parts of this country, and the necessary excavations required in the making of them, there probably never was a time more favourable to the researches of the geologist than the present; and it is sincerely to be hoped that no spot will remain untouched, the examination of which holds out a prospect of adding to our knowledge of the strata of the earth. It is my intention in the following memoir to notice more particularly those remains of the London clay which I have recently collected from that portion of the London and Birmingham railroad which passes in the immediate neighbourhood of Chalk Farm. I shall, however, occasionally advert to discoveries made in other parts of this important and highly interesting formation, which, having closely examined it in different places, I find contains many minute and exceedingly curious fossils, well worthy the attention of the naturalist. Before proceeding to a detail of the organic remains, it may be as well to give a short sketch of the relative position and appearance of the clay here, although there may be no perceptible difference from other places where this stratum has been exposed. Immediately beneath the vegetable mould is a thin bed of diluvium, containing a few bones of animals; and below this is the London clay, which may be easily traced along the line of road, from Chalk Farm to a field in front of Mornington-place, Hampstead road. This portion presents to the eye a reddish or yellowish brown colour, with occasional patches of blue. It is of a loose texture, and contains septaria, casts of shells, selenite, and decomposing masses of sulphuret of iron. In the tunnel, about 60 feet below the most elevated part of the surface, the clay assumes a dark bluish brown colour, and is much more compact, although here and there mixed with sand. The greater part of the organic remains are pro-

* Philosophical Magazine, No. 57.

† Read before the Camden Literary and Scientific Institution, April 26, 1836.

cured from the depth of from 30 to 60 feet, and very few have been seen in the septaria. A few days since I observed at the top of Park-street, Camden Town, where the men were working at the depth of 10 or 12 feet, a layer of masses of septaria horizontally disposed; this is of common occurrence, and the septaria are sometimes of a very large size. The fossil copal, or Highgate resin, so abundant at the Highgate Archway, occurs here but rarely. Fossil fruits analogous to those of Sheppey, crabs, lobsters, sharks' teeth, scales and vertebræ of fish, and the remains of a Trionyx, or marine turtle, have been found. If three divisions of the formation were made, I should consider the following fossils as characteristic of each division, viz. Upper *Murex coronatus, Modiola elegans, Cardium nitens* and *Pectunculus decussatus*, as at the Highgate Archway. Middle, *Pholadomya margaritacea, Cardium semigranulatum, Nautilus regalis, Nautilus centralis*, and *Terebratula striatula*, in the Regent's Park. Lower, *Axinus angulatus, Pentacrinites subbasaltiformis*, as found at Islington and in the cliffs between Herne Bay and Whitstable, which are capped with diluvium resting on the London clay. In enumerating the characteristic shells of each division, I have principally selected those which are most abundant in it, and which are either very rare, or not found at all in the other divisions. For example, the *Nautilus centralis, Nautilus regalis*, and *Cardium semigranulatum* are only found in the middle division. The *Axinus angulatus* is very common in the lower, exceedingly rare in the middle, and does not occur in the upper division. And lastly, the *Pectunculus decussatus* and *Cardium nitens* abound in the upper, and are very scarce in the middle. In making a collection of fossil shells I have endeavoured to procure them at several periods of growth: this is the more desirable, since it is well known that many shells vary so much at different steges of growth, as to appear to be of several species, when they in reality belong only to one. That there are considerable difficulties in the way of accomplishing this object I admit, but the result whenever it can be done, is most satisfactory. Then follows a classed list, including all those (railroad) shells, figures of which will be found in the first six volumes of Sowerby's Mineral Conchology. Several of the localities are also taken from the same work. Among the unfigured shells are the following genera; *Phasianella, Tornatella, Eulima, Cerithium, Pleurotoma, Pyrula, Voluta*,* &c.

Fifty-five species are enumerated in the list, besides which I have (from the railroad) forty species which have as yet not been figured as British shells, independently of a few, which are extremely minute, of the order Cephalopoda (Foraminifera), consisting of Spirolina, Orbulites, Nummulites, &c., making altogether above one hundred species. A part of the unfigured shells having also been found in digging a well at Lower Heath, Hampstead, plates of them, with descriptions, will be given in the Geological Transactions, to illustrate a paper read before the Geological Society on the 4th of June, 1834;† the remainder will appear in some of the early numbers of the continuation of Sowerby's Mineral Conchology. I have several examples of the *Nautilus regalis*, which present a very singular marking. A number of serrated lines may be seen in the outer lamina

* Note by Mr. J. De Carle Sowerby.—One species of Voluta nearly resembles *Voluta Lamberti*, differing from it however in having a longer spire and in being more oval. I propose to name it *Voluto Wetherellii*, as a just tribute to the author of this paper.

† Proceedings of the Geological Society of London, vol. ii. page 93.

of the shell, running across it, and generally two or three parallel to each other. Although they pass some depth into the substance of the outer lamina, they do not, as far as I have hitherto observed, extend to the inner one. The great zeal which Mr. J. De C. Sowerby has always evinced in the advancement of science has induced me to give his name to a new species of Nautilus which I have discovered at the railroad.*

ASTRONOMICAL AND METEOROLOGICAL.

FORMATION OF HAIL.

M. De la Rive thus concludes a paper on this interesting inquiry, in *Jameson's Journal*, No. 42:—

1st. It appears that hail is formed during the prevalence of winds of impulsion, and not of those of inspiration, which, however, are generally more violent than the former. The storm of the 13th of July, 1788, concerning which M. Tessier made a report to L'Academie des Sciences, goes to confirm this opinion. Its velocity was nearly the same as that of July 28, 1835.

2nd. Two strata of clouds, placed the one over the other, and two winds from different quarters, seem necessary for the production of hail.

3rd. The hailstones do not pass from one cloud to another, as Volta supposed; on the contrary, they advance with very great horizontal rapidity, and are urged forward by an extremely cold wind.

4th. Electricity, nevertheless, plays an important part in these phenomena; and, according to all appearance, the superior cloud supports the inferior, heavily loaded with hailstones, and probably in a state of opposite electricity. There is probably also electrical repulsion among the hailstones which form the anterior extremity of the cloud, and which there present the whirlwind-like phenomenon which is so remarkable, and which I have twice observed in the most distinct manner.

5th. The hailstones do not strike against each other during their horizontal transport; and the noise which is heard, that rolling murmuring which is perceived at so great a distance, is owing to the combination of the individual sounds produced by each hailstone cutting the air with such swiftness. The clashing of any hailstones during their progress causes them immediately to descend.

6th. We are led to suppose that the hailstones are subjected to a rapid rotatory motion, but my opportunities have not yet enabled me distinctly to see it.

7th. The formation of hailstones, and their increase, appears owing to cold produced by the evaporation at their surface, on account of their great velocity. The hot air into which the anterior edge of the cloud

* Philosophical Magazine, No. 56.

penetrates, leaves a portion of water deposited upon them, a part of which is evaporated, and thereby congeals the other part, and thus forms concentric layers round the nucleus; the wind unceasingly transports the hailstones into new portions of air which is saturated with moisture, and the upper cloud supports them in their progress. But the lower cloud rapidly increasing in density, by degrees falls down, and separates itself, more especially on its anterior portion, from the electrical cloud which supports it, till it reaches that point in which the action of this latter is almost nothing; the hailstones being all electrified in the same manner, then strongly repel each other, and present that violent agitation which is perceived at the surface of the earth, and which repels in all directions those hailstones which the wind reunites by imposing upon them its own direction.

8th. The presence of long crystals at the opposite poles of the hailstones of the 28th of July, 1835, would indicate that those which were placed at the equator were destroyed during their descent by the rotatory motion, or that this same movement hindered them from being formed upon the equatorial portion on account of their velocity, whilst they were easily grouped upon the poles.

9th. The water procured from the melting of the hailstones was far from being pure.

REMARKABLE DEPRESSION OF THE BAROMETER.

The barometer at the Royal Observatory, Greenwich, at noon on the 28th April, stood at 28·525 in.; a depression which has not been observed at this season for more than thirty years. The day was rainy, and there was some wind at night: nothing more remarkable was observed.

Professor Daniell gives the following as the barometrical points of March in London :—

	Inches.
Greatest height	30·770
Mean height	29·843
Least height	28·870

The depression on the 28th of April was, therefore, lower than the least height here given, by 0·345 in.*

NEBULÆ OF THE SOUTHERN HEMISPHERE.

At the anniversary of the British Association, Sir William Hamilton read a letter recently received from Sir John Herschel, at the Cape of Good Hope, giving an account of the progress of his observations on the nebulæ of that part of the southern hemisphere, a description of several of which he had forwarded to Professor Schumacher, for insertion in his *Astronomical Ephemeris*.

As an instance of the clearness of the sky, it was stated by an observer, that in forty-two successive days, there were only three in which he could not see Venus in broad day-light; and Sir John Herschel stated that he had also written a letter by the light of an eclipse of the moon. Under these circumstances, the starry heavens presented a bril-

* Magazine of Popular Science, No. 4.

liance of which the inhabitants of the northern hemisphere can have no conception; the line from Orion to Antinous being remarkably rich and brilliant, appearing as a continuous blaze of light, with, however, a few patches of the sky destitute of stars. The Magellanic clouds were described as curious objects, differing from other nebulæ apparently in the greater degree of condensation of the stars of which they were composed. He had also observed several planetary nebulæ, the appearance of some of which gave him, at first, the idea that they were real planetary bodies; and it was not until after he had observed one several times, that he could divest himself of the idea that he had discovered a new planet more inclined than that of Pallas.*

TEMPERATURE OF SPACE.

The result of some reflection upon the degree of cold, registered by Captain Back, when in the Polar regions, induced M. Arago to state to the Academie des Sciences, that it was his opinion the temperature of celestial space could not be lower than the maximum of cold mentioned by Captain B., viz. 102° Fahr. below the freezing point.

M. Poinsot, on the contrary, thought such a consequence ought not to be drawn from the data, and contended that the temperature of the upper strata of the atmosphere must necessarily be lower than that of space.†

CURVILINEAR DIRECTION OF WINDS.

Careful and continued observations, contained in the annual reports furnished by the several academies in the state of New York, to the Regents of the University, appear to demonstrate the fallacy of the notion commonly entertained, that winds are generally rectilinear in their progress, and blow for the most part in right lines over extensive portions of the earth's surface; an error which appears to remain undisturbed in the minds of most meteorologists.‡

ON THE SUPPOSED EXISTENCE OF A NEW SMALL PLANET.

By M. Cacciatore, Director of the Observatory at Palermo.

On the 15th of February, M. Arago read to the Academie des Sciences, the following extract from a letter communicated to him by Captain Hall, and which had been addressed by M. Cacciatore to Captain Smyth. "I have something important to communicate to you. During the month of May, 1835, while I pursued observations, with which I have for a long time been occupied, on the proper movements of stars, I saw, near the seventeenth star of the twelfth hour of the catalogue of Piazzi, another star, which seemed to be also of the seventh or eighth magnitude; I noted the distance which separated them. The weather did not permit me to observe during the two following nights. It was only on the third that I again saw the new star; it had moved a good deal towards the east and towards the equator; clouds forced me to delay my observations for another night; but from that time till the end of

* Magazine of Popular Science, No. 8.

† Ibid., No. 10. ‡ Ibid., No. 1.

the month of May, the weather was dreadful; the winter seemed to have recommenced at Palermo: heavy rains, and violent winds succeeded, and to such an extent, as to prevent all kinds of researches. Fifteen days afterwards, when I was again able to proceed with my observations, the star was immersed in the twilight of the evening, and all my efforts to find it were fruitless; the stars of that magnitude were no longer visible. The estimated movement, in three days, seemed to me 10″ in right ascension, and about one minute (or a very little less) in declination, towards the north. A movement so slow, induces me to suppose that the star is situated beyond Uranus. I felt great disappointment at not being able to follow up an investigation so important." On this subject M. Arago makes the following observations: "There is in this communication a circumstance which astronomers will have much difficulty in understanding. M. Cacciatore says, that when the weather became favourable at Palermo, towards the end of May, the moving star was no longer visible, owing to the crepuscular light of the evening. This explanation is admissible when the question regards the passage of the star to the meridian; but two or three hours after sunset, or at night, nothing could prevent the comparison of the suspected planet with the neighbouring stars, either by means of a parallactic machine, or with the great azimuth circle, which holds the first rank among the instruments of the observatory at Palermo. It seems to us inconceivable that an observer so meritorious as M. Cacciatore, opposed by unfavourable circumstances though he was, should not have been able to confirm the truth of such a capital discovery,—that he should not have judged it proper to follow the star beyond the meridian.*

PERIODIC APPEARANCE OF SHOOTING STARS.

M. Arago has recently given publicity to the notion that millions of groups of opaque bodies floating in space, may, in their periodical revolution, annually cut the path of the earth near that point of the ecliptic where our planet may be found about the middle of November; and that, on entering into our atmosphere, these bodies may inflame, and so become visible to us. He draws this conclusion from the reports of several observers of different nations, who have described appearances of this class of meteors which were remarkable for numbers and brilliancy; but more particularly from the circumstance, that though observed in different years, they all occurred on or about the 13th day of November.†

EFFECTS OF THE GAS IN THE CITY OF LONDON ON THE ATMOSPHERE.

By W. H. White, Esq.

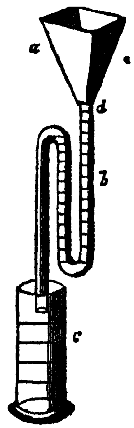
During the severe frost between Dec. 19 and 27, 1835, I observed the streets in the City to become very dirty after the evening closed in; so that I more than once was led to the conclusion that a rapid thaw was taking place; but when I came near to my house (three miles south of London bridge,) I found the roads quite hard, and the trees still covered

* Jameson's Journal, No. 40.
† Magazine of Popular Science, No. 1.

with their icy crystals: this led me to the consideration that the difference of temperature in the City was owing to the heat given out by the gas. It was, however, no great difficulty to make the experiment with the thermometer; in doing which, I found that the temperature during the day, in the City, was 3° Fahrenheit higher than at my house; and that, after the gas in the City had been lighted four or five hours, the temperature increased full 3°: thus making the difference of 6°, and sometimes as much as 7°, in the space of three miles.

This notice, though unimportant in itself, may, probably, lead to further experiments, and to other useful applications of the gas than merely the light from its brilliant flames.*

SIMPLE RAIN GAUGE.



THIS rain gauge is simple, and yet indicates accurately so small a quantity of rain as the thousandth of an inch. Any one may construct one for himself. — *a*, a tin funnel, japanned; *b*, a glass tube, bent twice, so that the extremity of it may form a siphon, and conduct the contents, when filled up to *d*, into the jar *c*. "The funnel having a square orifice of 5 in. or 10 in., the proportion between the surface exposed and that in the tube is easily arranged: for instance, the funnel's orifice, 10 in. square, one hundredth of an inch of rain falling, gives 100 times that quantity, or exactly a cubic inch of rain in the tube; which is easily graduated by pouring in that bulk of water, accurately measured, and marking with a file where it rises to in the first two legs. The division into ten parts for a thousandth of an inch may afterwards be done by a rule. The graduation in the jar must be for successive contents of the tube. The whole is to be inclosed in a small box.†

AURORA BOREALIS.

AT the anniversary of the British Association, Mr. Herapath thus described the aurora seen on the 18th of November, 1835.

About nine o'clock on the evening in question, a heavy and well-defined cloud bounded the north-western horizon. It was surmounted on its upper curved surface by pale phosphoric light, which seemed to radiate from that surface, and occasionally, or in fact frequently, waves (or, as they are usually called, "streamers,") flitted from the principal light, proceeding to different distances, but in the same direction, and sometimes passing the zenith. These varied repeatedly in form, magnitude, and solidity; yet they were always so rare, that the stars (which were very bright at the commencement,) were visible through their substance. It would have been impossible, in the darkness, (the aurora furnishing the only light,) to form a judgment of the distance or the height of the

* Magazine of Natural History, No. 59.
† Magazine of Natural History, No. 64.

pale light, or of the streamers proceeding from it; but, after keeping the eye fixed upon it for some time, I observed, that although the cloud had seemed immovable, yet that small portions were being constantly detached from it; these were drifted away, and rapidly dissolved, none of them reaching the zenith; and, upon a large fragment having been blown off, it was surrounded by the same diffuse light as appeared on the great mass of cloud. Having once seen this, I looked still closer after every fragment, and found that they all presented the same appearances. As the light declined, the detached portions were dissolved with more difficulty,—the air became hazy, and by half-past ten all was gone, the atmosphere being cloudy.

It was evident, then, that the cause of the aurora was something that attended upon water, as found in clouds, and that it was evolved during the solution of that water in air. The cloud itself was clearly electrical, being of the nimbus variety, and in the midst of the streamers; I twice perceived a short, faint blue electrical spark, just as I have seen when imitating the aurora in a partially exhausted flask, when the electrical spark happened to be a little too strong. There is a very strong probability, therefore, that aurora is merely electricity passing off from a charged cloud in the act of dissolving in air, that can take its water but not its electrical fluid, which fluid, while dispersing through a rare atmosphere, becomes evident to the eye.*

LUMINOUS APPEARANCE AT SEA OFF THE SHETLAND ISLES.

A curious luminous appearance at sea is mentioned in the following extract from a letter to Robert Stevenson, Esq., engineer, by the light-house keeper on Sumburgh Head, in Shetland:—"Monday, September 19, 1836,—Sumburgh Head Light-house.—The herring-boats went out through the night—there came on a severe gale of wind from the north-east, which drove them from their nets, and scarcely any one of them got into their own harbours. Mr. Hay's fishermen lost 180 nets; Mr. Bruce, of Whalsey, lost 114 nets, and a great many of the poor men lost the whole of their nets. The fishermen also informed me, that upon the same night, there appeared to them a light which greatly annoyed them. It appeared like a furnace standing in the water, and the beams of the light stood to a great height. It became fainter on the approach of day, and at length vanished away by day-light. It continued for two nights. It stood so near some of the boats, that the men thought of cutting from their lines to get out of its way."†

PHOSPHORIC LIGHT EMITTED BY FLOWERS.

On Nov. 6, at a meeting of the Ashmolean Society, at Oxford, a communication was read by Dr. Daubeny respecting an electrical phenomenon, which occurred in the garden of the Duke of Buckingham, at Stowe. On the evening of Friday, the 4th of September, 1835, during a storm of thunder and lightning, accompanied by heavy rain, the leaves of the flower called *Œnothera macrocarpa*, a bed of which is in the garden, immediately opposite the windows of the manuscript library at

* Magazine of Popular Science, No. 8.
† Jameson's Journal, No. 43.

Stowe, were observed to be brilliantly illuminated by phosphoric light. During the intervals of the flashes of lightning, the night was exceedingly dark, and nothing else could be distinguished in the gloom except the bright light upon the leaves of these flowers. The luminous appearance continued uninterruptedly for a considerable length of time: it did not appear to resemble any electric effect: and the opinion which seemed most probable was, that the plant, like many known instances, has a power of absorbing light, and giving it out under peculiar circumstances.*

SOUTH COLDER THAN THE NORTH.

The attention of meteorologists is requested to the fact, that in the two last months of 1835, the depression of the thermometer was greater, and commenced sooner, in the south, than in the north, of France. And also, that in the Puy-de-Dôme, a department a little south of the centre of that country, it was not the north winds, but violent ones from the west and south, which produced the greatest cold.†

MIRAGE IN ICELAND.

"We have had very often the phenomenon of the mirage under observation; and, contrary to the opinion of some navigators who have visited the north, I was never able to remark that objects were elevated by it. It always appeared to me like a bright fog on the surface of the sea, which, variously modifying the bases of objects, might, I believe, in certain circumstances, so influence the illusion, as to give an idea of their being elevated by the phenomenon.—Robert."—*Letter from Iceland, July*, 1836.

When this extract was read in the Academie des Sciences, M. Libri remarked, that it could not be affirmed, as M. Robert appeared to do, that objects were not elevated by the mirage, for this phenomenon, which takes place under very different circumstances, produces very varied effects. In the sandy countries of the south, lakes and sheets of water are seen during the mirage, while in the north, and at sea, it is very distant objects only, and even those below the horizon, that are visible. As to whether these objects shall be seen elevated, more or less, by the effect of the mirage, that will principally depend upon local circumstances, and the state of the atmospheric strata through which the rays must pass which emanate from the objects affected by the phenomenon.‡

CLIMATE OF PALESTINE.

In the Annuaire of 1834, M. Arago published a memoir, which had for its object to prove that, since the time of Moses, the temperature of Palestine has undergone no sensible alteration. The Duke of Ragusa denies the accuracy of the facts on which the conclusion is founded. He says, "There are now no palms in the part of Palestine indicated by the memoir." But, nevertheless, I find, farther on in the Marshal's communication, "that there are a few at Jericho;" that at Jerusalem he

* Magazine of Popular Science, No. 1.
† Ibid., No. 2. ‡ Ibid., No. 12.

saw three "nearly barren;" at Rama, a place cited in the article in question, "there are some which yielded fruit:" but, certainly, if there are some at that spot, a great many might exist. One single palm-tree producing ripe fruit, would be sufficient in a question as to the temperature. The limit assigned, in the same article of the Annuaire, to the cultivation of the vine, is also called in question. We here transcribe this portion of the memoir, in order that botanists themselves may decide if the facts adduced by the Duke of Ragusa are of a nature to modify their old opinions. "The article fixes at between 21° and 22° cent., (69°·8 and 71°·6 Fah.,) the maximum of temperature that the vine can bear when productive, and, to justify this assertion, it states, that at Cairo, where the mean temperature is 71°·6 Fahr., the vine is not cultivated on the great scale, and that there are there only detached vine-plants. This is the fact in regard to the past, but then the cause is quite of another description. Considerable plantations of vines have lately been made, which promise to afford excellent returns; but a decisive fact is, that there have always been, and still are, vines in Fayoum, which is one of the hottest provinces in Egypt, owing to the hills of sand which surround it on all sides. These vines are situated at the villages of Fidemia, Adjamira, and Tumban; they are cultivated by the Cophts, and yield agreeable wines. That which I have drunk presents a phenomenon which is rare in such a climate; it does not affect the head, and is drinkable after the second year. Pococke, who travelled in 1737, speaks of the cultivation of the vine by the Cophts in Fayoum; and, what is still more important, there is in the higher part of Upper Egypt, at Esné, twelve leagues to the south of Thebes, a vineyard which has an extent of several feddams. Its original object was, doubtless, to yield grapes for eating; but Jussuff Kiacheff, formerly soldier in the army sent to Egypt, and who was taken prisoner by the Mamelukes at the period of the evacuation, and remained in the east, informed me that he farmed the vineyard; that he made excellent wine of the produce, and obtained a quantity equal to that afforded by the vineyards of Europe. We may then conclude from these facts, that if in Egypt, till within a few years, the vine has not been cultivated on a great scale, it is because the inhabitants do not drink wine, and that we are not to draw the inference, that there is a maximum of temperature above which the vine does not yield the means of making wine."*

TEMPERATURE OF LONDON IN 1835.

From observations made regularly by Mr. Webster, at No. 43, Cornhill, London, the mean height of the thermometer for the year 1835, at that place, was 30·836° Fahr. This is rather higher than the mean of the last fifteen years, which Mr. Webster states to be 29·562° Fahr.†

RETURN OF RAIN-WATER TO THE SEA.

One-third only of the water which falls in rain, within the basin of the Seine, flows by that river into the sea; the remaining two-thirds either

* Jameson's Journal, No. 40.

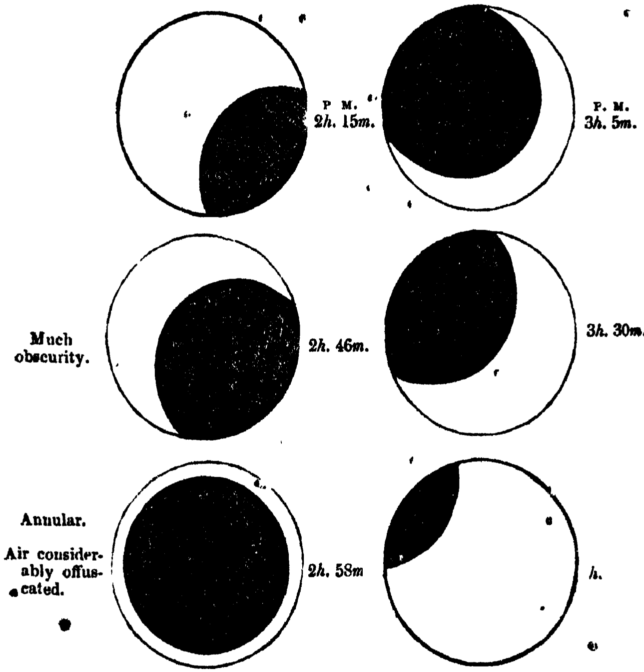
† Magazine of Popular Science, No. 8.

return into the atmosphere by evaporation, or go to the support of vegetable and animal life, or find their way into the sea by subterranean passages.*

ANNULAR ECLIPSE OF THE SUN.

Extract of a Letter from R. V. Yates, Esq., of Toxteth Park, Liverpool, dated Edinburgh, May 15, 1836.

"We have just enjoyed a most glorious sight, an annular eclipse. The morning arose cloudy, and gave little promise; but about 10 the clouds cleared off, and during the whole period of the eclipse nothing interfered with our seeing it perfectly. It was curious to watch it when it was just going to become annular, the light broke in so rapidly. It remained annular only a very short time, perhaps between 5 and 10 minutes."



In a garden near Birmingham, the gentians partially closed their flowers during the eclipse, and then opened again.†

* Arago; Annuaire, par le Bureau des Longitudes, 1835.
† Philosophical Magazine, No. 50.

The following notes are from an observer, at Blackheath Hill, near London.

About the middle of the eclipse, the light assumed a very faint hue, similar to that of very early morning or late evening. The diminution of temperature at this time gave to the human frame a sensation of evening chilliness, to such a degree that the garden-flowers, around the lawn at the place of observation, appeared closing, as if for the night. The poultry commenced retiring as early as six minutes past three, and at the time of greatest obscuration, nine hens and a cock, being the whole of the family, had gone to roost.

Appulses of the moon's limb to several of the numerous spots on the solar disk were also observed.

The day very fine, and nearly cloudless; a strong haze, occasioned by the London smoke, to the westward; the barometer about 30·60, and nearly stationary, only the diurnal falling perceptible, viz. about ·03. The thermometer at the commencement of the eclipse,—

In the sun - - -	81 deg.
In the shade - - -	67

And at the greatest obscuration, (or a little after,)

In the shade it had fallen to - -	62 deg.
In the sun to - - - -	66
And the Radiator on the ground to - -	59

The dew-point, by Daniell's hygrometer, marked twelve at the commencement, and only seven at the time of the greatest darkness, or, to be plainer, the point of deposition was as high as 57°.

The sky, when clear and free from haze, assumed a much deeper blue, and the gloom was very considerable. The foliage of the trees appeared tinged with orange colour. The planet Venus was seen, about three o'clock, with the naked eye. There was a little wind from the NE., but just after the middle of the eclipse it suddenly changed to the S. and SE., blowing fresh and cold as to sense; after sunset, it gradually got back to NE. Towards evening, I looked out for Venus, and about a quarter of an hour before sunset estimated her brightness to be the same as during the middle of the eclipse; from which it may be inferred, that daylight was diminished to nearly sunsetting. At the time of the greatest darkness, the birds appeared agitated, and among domestic fowls there were evident signs of alarm, the cocks filling the air with their continued crowing.*

Dr. Sigmond has remarked, that during the eclipse, when the rays of the sun were most obscured, the flower of the crocus, a very delicate index of light, began to close immediately it was diminished, and assumed every appearance of what Linnæus terms the sleep of plants.

* Magazine of Popular Science, No. 5.

METEOROLOGICAL SUMMARY OF 1836.*

MONTHS.	TEMPERATURE. Max.	TEMPERATURE. Mean.	TEMPERATURE. Greatest Variation.	ATMOSPHERIC VARIATIONS. Mean Pressure in Inches.	ATMOSPHERIC VARIATIONS. Prevailing Currents.	HYGROMETER. Lowest.	HYGROMETER. Mean.	HYGROMETER. Mean quantity of Rain in Inches.	MODIFICATIONS OF CLOUD. Cirrus.	MODIFICATIONS OF CLOUD. Cirro-stratus.	MODIFICATIONS OF CLOUD. Cumulus.	MODIFICATIONS OF CLOUD. Cirro-cumulus.	MODIFICATIONS OF CLOUD. Cumulo-Stratus.	MODIFICATIONS OF CLOUD. Nimbus.	MODIFICATIONS OF CLOUD. Stratus.
JANUARY	56	20	45	29·61	SW. W. NW.	10	34·2	1·434		+		·	·	·	
FEBRUARY	53	36	33	30·25	NW. SW.	18	34·9	0·746		+	·	·	·	·	
MARCH	72	49	46	29·20	SW. W.	20	29·3	1·344		+	+	·	·	·	
APRIL	68	48	39	29·26	SW. NW. W.	28	43·5	1·732	·	+	+	·	·	·	
MAY	75	54	42	29·49	NE. E.	29	45	1·852		+	[illegible]	·		·	
JUNE	82	62	43	29·85	SW.	36	50·4	1·820	·	+	+		·	·	
JULY	96	69	54	29·75	SW.	40	54·2	2·494		[illegible]	+	+		·	
AUGUST	80	60	40	29·80	SW. NE.	47	55·3	1·442	·	+	·	·	·	·	
SEPTEMBER	82	58	48	29·52	SW. N. W.	38	52·4	2·132		+	+	·	+	·	·
OCTOBER	65	44	41	29·34	W. SW. N.	32	44	2·174		+			·	·	·
NOVEMBER	58	42	32	29·22	SW. NW.	25	40	2·872		+		·		+	·
DECEMBER	58	42	32	29·57	SW. NE.	18	38·4	2·428		+				+	

Number of Days for the greater part rainy .. 42 | Number of Days for the greater part fair .. 279
Number of Days fair, but cloudy throughout .. 114 | Number of Days clear and cloudless 26

The degrees of temperature are ascertained from a self-registering thermometer, graduated by Ronketti, and suspended at the height of 28 feet, and facing the north, aspect east.

The averages of atmospheric pressure result from observations taken from a traversing barometer, by the same maker.

The highest winds were on Jan. 13, 22, 23, 28, 29: Feb. 3, 4, 5, 17, 18; March 1, 4, 11 to 18, and 26, 30, 31; May 2, 3; Oct. 12, 13, 14, 27; Nov. 23, 27, 28,—violent hurricane on the 29th; Dec. 3, 4, 25, 26.

Highest Tides on Feb. 17, 18; March 18; May 2; Oct. 13, 14.

On Feb. 22, the atmospheric pressure was 28·15, the least for a number of years back.

Thunder on June 19; a violent thunder-storm, accompanied by a destructive hail-storm on the 29th. Thunder also on July 21, Aug. 13, 14.

During the great Solar eclipse, the greatest variation of temperature was 5°. The temperature at the appulse being 75°; at the greatest obscuration, 70°, in the open air. The atmosphere lost and regained its warmth in a reciprocal ratio.

An Aurora Borealis on Oct. 18, similar in its general character to that which will be found described in our last volume.—A brilliant Fire-ball on Aug. 28, about 9 P.M.

A heavy fall of snow on Oct. 29. Snow-storm of disastrous severity, and general throughout Britain, on Dec. 26.

* Constructed for, and communicated to, this work, by Dr. Armstrong, Vauxhall.

RURAL ECONOMY.

Upton's Steam-Plough.—This steam-plough is worked by Upton's patent lever steam-engine, and his air furnace boiler. If a single-shared plough, the space occupied by the entire machine will be four feet long by ten feet; if for trench ploughing, the dimensions will be the same; if for ploughing two, three, or more parallel furrows at once, then the breadth and length will be about five feet by twelve feet. The work done by the trenching plough will be equal to any spade husbandry; and that by the parallel shares will be found very superior to any horse ploughing; inasmuch as the ground will not be trod and rammed down by horses' feet; and as the stearer or ploughman, &c., will ride on the machine, the land will be left as open and light as possible, and resemble that of garden culture. To the steam-plough a harrow, drill, and seed-box can be attached when requisite, and the entire operation performed at one going, when it is for the last ploughing, without trampling the soil. The spots left in the angles of the field by Upton's steam-plough will be smaller than by any horse-plough, as the steam-plough will turn, if a single share, in thrice the breadth and length of a common wheelbarrow; and if a three-shared plough it will turn in the space of a small one horse cart. The simplicity of construction and small number of parts composing this steam-engine and boiler, and the great safety and security of the latter, will prevent the necessity of frequent or expensive repairs, as the only parts of the apparatus most liable to wear and tear are the ploughshares, the soles, coulters, and harrow tines, which will only require the same repairs as if drawn by horses. The engine and its boiler is calculated to go 50,000 miles or more, before any repairs could be wanted, unless from accident or unfair usage, and whenever, from long use, very much worn, if the boiler were to burst, it could only extinguish its own fire without injury to any person close to it. The plough will require one steady man to direct or steer it, and a tractable boy to attend the fire and turn the steam off and on occasionally, the engine being of the most simple and efficient construction. The water tank will require replenishing now and then, and perhaps fuel will be required two or three times in the course of the day, and the boiler is admirably constructed for burning either wood, peat, or coke, or coal may be used. The single plough is calculated to do two acres per day, and as the person will not be fatigued by walking over the rough ground, nor have any horses to rub down and feed after coming home from the field, they could remain out a longer time. The double plough would do four acres, and the three-shared plough would do about six acres per day. The counter or trencher plough would do about two acres per day; but as it would be equal in power to the double-shared plough it would require the same quantity of fuel and expense.—*Quarterly Journal of Agriculture, No.* 34.

Draining Tiles of Peat.—An ingenious spade has lately been invented by Mr. Hugh Calderwood, Blackbyres, Kenwick, Ayrshire, for cutting draining tiles of peat. The instrument is worked very easily, and forms

the tile with one cut of the spade; the tiles being cut one out of the other expeditiously, and without waste of material. Their shape is something like clay tiles, but more massy. They are dried in the sun during summer, lying flat on the ground, and may be stacked like peats, ready for use when required. When properly dried and hardened, wetness will not soften or decompose them.—*Quart. Journ. Agric.*, No 34.

A Moving Bog in Ireland.—This rather rare phenomenon has been witnessed on a part of Lord O'Neil's estate, in the neighbourhood of Randalstown, on the Ballymena road, and about two miles and a half from the former town. "On the 19th of September, in the evening, the first movement occurred. A person who was near the ground was surprised to hear a sort of rumbling noise, as if under the earth; and immediately after, his surprise was not a little increased, on perceiving a part of the bog move pretty rapidly forward, a distance of a few perches. It then halted, and exhibited a broken, rugged appearance, with a soft peaty substance boiling up through the chinks. It remained in this state till the 22nd, when it suddenly moved forward, at a quick rate, covering corn fields, potato fields, turf-stacks, hay-ricks, &c., not a vestige of which now remains to be seen. So sudden and rapid was this movement, that the adjacent mail-coach road was covered, in a few minutes, or rather moments, to a depth of nearly twenty feet. It then directed its course towards the river Maine, which lay below it; and so great was its force, and such the quantity of matter carried along, that the moving mass was forced a considerable way across the river. In consequence of the late heavy rains, the river has again found its channel through the matter deposited in its bed, otherwise the water would have been forced back, and immense damage done to the land on the banks. The fish in the river have been killed to a great distance. The damage done by the mossy inundation has been very considerable. About 150 acres of excellent arable land have been covered, and rendered totally useless. Down the middle of this projected matter a channel has been formed, through which there is a continual flow of dark peaty substance, over ground where only two weeks ago the reapers were at work. A house close by the road is so far overwhelmed, that only a part of the roof is to be seen. Besides the actual damage sustained, the utmost alarm prevails, and the people living adjacent to the place have been removing their furniture, &c., to a distance. All manner of absurd reasons are assigned to account for the destroying visitation, but as the cause is one of a natural and sufficiently well ascertained kind, it is useless to dwell upon the solutions offered by ignorance."—*Northern Wig, October,* 1835.—*Quarterly Journal of Agriculture, No.* 34.

New Agricultural Plants.—We have the gratification of introducing some new varieties of field plants to the notice of our readers. They are:—1*st, Hickling's Prolific Wheat.*—Mr. Samuel Hickling, Cawston near Aylsham in Norfolk, observed, in 1830, three heads of wheat remarkable from the rest, apparently from one root, which he plucked and rubbed out, and found to contain 293 kernels. Having preserved and sown them and their produce for four successive years, the seed in the fourth year covered eighteen acres of ground, and the return was 6½ quarters per imperial acre. Hence the name Hickling's Prolific Wheat. The properties of this Wheat are—straw long, stout at the bottom, and tapering to the head; head short, thick, close, and heavy; kernels four in the row across the ear, and red in colour, with the chaff white; in sample, the

wheat is short, plump, thin-skinned, and looks as if it would flour well; colour dark orange-red. It has been tried for two seasons in Scotland, and if it approaches any thing near to what we have heard stated of its produce, namely, 9 quarters per Scotch acre, it well deserves the appellation of prolific.

2nd. Whittington's Wheat.—This variety was introduced by Mr. Whittington, Whitmore House, near Ripley, Surrey. This is a very different wheat from the one just described. The straw is long and very strong like a reed; the head long, and strong, the capsules being so far set apart as to permit the spike to be seen; in sample, the grain is longish, inclined to flintiness, thin skinned, yellowish-white colour, and appears to flour well, the produce is estimated at five quarters per imperial acre. This is evidently the same wheat as that which passes by the name of Wellington.

3rd, Smoothey's, or Boxshall New Red Wheat.—This variety was discovered by Mr. Thomas Smoothey, Boxshall, near Halsted, Essex. It is a decidedly red wheat both in grain and straw. The straw is fine; ears short, thick, and close set. The sample which we have seen of it not having filled this season, and having been raised under very unfavourable circumstances, disables us from describing the grain correctly. The produce has been rated as high as seven quarters per imperial bushel.

4th, Waterloo Red Wheat.—This variety was raised at Wickham, in Suffolk, but we have not learned the name of the discoverer. The straw is both long, strong, and stiff; heads are equally so; in sample the grain is longish, round, thin skinned, appears to flour well, and of light orange-red colour. Of its prolificacy we have heard no statement.

5th, Cumberland Early Oat.—So named from being raised by a gentleman in Cumberland a few years ago, from a single head. In sample it is a longish grain, and more like the early Angus variety than the potato; colour dark, and dull. It is as much earlier than the potato oat, as the latter is earlier than the Hopetoun, being nearly a fortnight earlier than the Hopetoun. Of a trial this year of this oat with the potato and Hopetoun on two ridges each, in the same field, on the farm of Hawkhill, Mr. Thomas Chrisp found the differences between them to be these:—Produce potato oats, 17 bolls 5 bushels; Hopetoun, 17 bolls 4 bushels; early Cumberland, 24 bolls; but the potato oat weighed a stone per boll more than each of the other two.

6th, Orange, Red, and White Globe Mangel Wurzel—The globe shape of these varieties of this root are better suited to shallow soils, the ordinary nature of arable land, than the long red variety. They may be planted 18 inches apart in the row, and 30 inches between the rows; and they yield as heavy a crop as the long red. The orange and red varieties are heavier than the white, but the white is the hardier root.—*Quarterly Journal of Agriculture, No. 35.*

On Tanks for Water. By Mr. J. Starr, East Bourn, Sussex.—Tanks have been eminently useful during the last three dry summers, at East Bourn, in Sussex, and as they are cheaply and easily constructed, and not liable to decay like wooden vessels, and as rain enough falls on every house in England for the use of its inhabitants, no family would be deficient in good soft water, who made a tank to retain it, and such tanks, being paved over, take up no room. The sizes at East Bourn vary; one of less than 7 feet deep and wide has served two labourers' families for three years, while most of the springs in the neighbourhood were dry. A tank twelve feet by seven feet has been found sufficient to supply with water

a large family and six horses; this was surrounded by only four and a half inch brick work resting solid against the sides, in consequence of being like a decanter smaller at the bottom than higher up, and the dome is constructed on the Egyptian plan by projecting horizontally each row of materials one-third of their length beyond those below, by filling up the back with earth as it proceeded, to balance the weight of this projecting masonry. At the East Bourn workhouse for fourteen parishes, a tank has been made twenty-three feet deep by eleven wide of the roughest materials, being only flint stones, and though they require more mortar than if they had been regularly shaped, only ninety bushels of lime were allowed, including two coats of plaster, and the workmanship is executed like field walls at 10s. per 100 square feet, the only essential being that no clay be used (which worms in time bore through) and that the lime or Parker's cement be good. A current of air is said to promote the purity of water in tanks, which is easily effected by the earthen-ware or other pipe which conveys the water from the roof being of 6 or 8 inches in diameter, and an opening left for the surplus water to run away, and where the prevailing winds do not blow soot and leaves on the house, the water remains good, even for drinking, without clearing out the rubbish more than once a year; but in some cases filtering by ascension may be found useful, and effected by the water being delivered by the pipe at the bottom of a cask or other vessel from which it cannot escape till it has risen through the holes in a board covered with pebbles, sand, or powdered charcoal. Upwards of 20 labourers' gardens have been watered by the rain which formerly injured the public road, and was therefore turned into a sink-well, which sink-well, enlarged and surrounded by nine inch masonry drawn up by a cast-iron curb—was used in planting potatoes, and occasioned good crops in 1835, when sets not watered failed. And should the profitable mode of stall-feeding, now practising at Armagh, be happily extended to Cornwall, and fatting oxen be kept in pairs not tied up under shelter, it will be found that preserving in tanks the water which falls on the barns and stalls will amply supply them, whilst it saves the rain washing away the strength of the manure in the open yard. Ponds have been made with equal success, dug four and a half feet only below the surface, what is excavated being added to the sides covered, and about one foot thick, like a road with pebbles and good lime mortar. Such ponds are become general on the dry soil of the South Downs for watering the large flocks of sheep—and had such ponds been found in Romney Marsh, &c., during the last dry years, the sheep would not have died in such numbers as materially to raise the price of meat in London, and would have raised it much higher, had not the large premiums given for many years by the Agricultural Society of Scotland enabled North Britain to supply a great proportion of the sheep, as well as oxen and oats, consumed in London.—*Cornwall Royal Gazette.*

Novel and Important Use of Ammonia or Brine.—The thanks of the Society of Arts were lately voted to a Mr. Webster of Ipswich, for a statement of the effect produced on potatoes by immersion in ammoniacal water, or in brine. If potatoes are immersed for four or five days in ammoniated water, containing an ounce of the common liquor ammoniæ to a pint of water, they will, on removal, be found to have their vegetative principle greatly checked, or altogether destroyed, so that they may be preserved throughout the year without the least deterioration of their general qualities. The temporary action of the ammonia in no way affects the potato beyond that of destroying its power of growth; if, however,

any change is produced, it is rather beneficial than otherwise, somewhat improving the appearance and flavour of inferior potatoes, and giving them a mealiness they did not possess. The transient nature of the application removes any suspicion of injury from the material employed, and it is all lost by evaporation, so that not a trace remains behind; nor could the most fastidious ever detect that the potatoes had been immersed in ammonia, so volatile is its nature, so perfect its escape. The exportation of potatoes to foreign climates, chiefly within the tropics, is an object of importance; and for the comfort of sailors there is nothing in the way of diet greater than the luxury of a potato with their salt food. As a means of prolonging their enjoyments, and adding to the healthful diet of a sea life, this mode may be adopted with advantage. The expense of immersion is very trifling, and they subsequently require to be spread in an airy situation to dry. Potatoes so treated have been used after ten months' keeping in a warm kitchen closet, and were found to be perfectly good. If the potatoes, instead of being removed in five days, are continued in the ammoniacal water for three weeks, the potato becomes tough and shrivelled while in the liquor, and, when dried by exposure to the air,

[illegible]

e effected on the potato, but merely a mechanical consolidation and extraction of moisture; for precisely the same effect may be produced by immersing potatoes in a strong solution of salt and water, taking care to remove by subsequent ablution the whole of the salt, and this requires some time, and repeated changes of water.—*Quarterly Journal of Agriculture, No. 35.*

The Gama Grass.—Messrs. Jacob Wrench and Sons, seedsmen, London Bridge, having received a bag of the seeds of this grass, and having requested us to give them some account of it, we think it might be useful, more especially as this grass is at present making a considerable noise in the United States, to lay some particulars respecting it before our readers. The Gama grass was so named in honour of the Spanish gentleman who first introduced its culture into Mexico. Its scientific name is Tripsacum dactyloides *L.* (*fig.* 1.); and there is a variety of it, T. monostachyon *W.* (*fig* 2.), which by some is considered as a species. T. dactyloides was introduced into England from Virginia in 1640; and T. monostachyon was brought to this country from North America in 1825; though we have not been able to ascertain where a plant of the latter species is to be found. There are plants of "T. dactyloides in the grass collection at Kew, which have been there a number of years. It is there a robust perennial grass, requiring no looking after as regards its cultivation, because neither heat nor cold, wet nor dryness,


(Gama Grass, Fig. 2.)


(Gama Grass, Fig. 1.)

appear to affect it. It is late in beginning to shoot; and its flower stems do not show till late in the summer. They are spreading, and from 3 ft. to 4 ft. in length. They continue green till destroyed by the cold nights in autumn. It does not appear that the seeds are sufficiently ripened to vegetate; at any rate, no plants have been raised at Kew from seeds ripened there."—*Gardeners' Mag.*, *No.* 74.

GARDENING.

A variegated, simple-leaved Ash has been discovered, and propagated for sale, by Mr. Henry Davies, Ogle's Grove Nursery, near Hillsborough, in the county of Down. A drawing has been shown to us from which the figure was reduced to the scale of 2 in. to 1 ft. The variegation is white and yellow, with very dark, and also with light, green; and it does not seem to be attended with that ragged and imperfectly developed appearance of the leaf common to most variegations. The plants are said to take the habit of shrubs rather than of trees.—*Gardeners' Mag.*, *No.* 66.

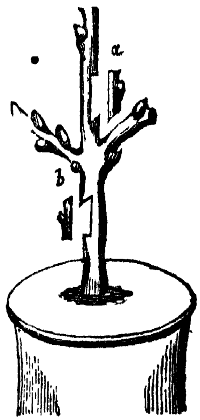
(Variegated simple-leaved Ash.)

Cultivation of the Strawberry.—Choose an open piece of ground, in a sunny situation. To prepare it for the reception of the strawberry-plants, open a trench full three feet deep; place in the bottom a good coating of rotten but unexhausted manure; trench the ground, continuing the same process till you have a patch prepared sufficiently large for your purpose. Before you plant your strawberries, dig in another coating of manure, and just bury it well under the surface: plant your strawberry plants at eighteen inches or two feet distance; this must depend upon the sorts that you are planting. If the ground is a good, holding, loamy soil, the strawberries will thrive the best; but in any tolerable soil they will thrive with this treatment. The roots of the strawberry dive deep into the earth, and just at the time the fruit is ripening, will receive support from the lower coating of manure, and swell off to twice or three

times the size that they usually attain. This process has been pursued by the writer with eminent success: and his friends who have tried it, have been delighted with the plan. Keen's seedling, the roseberry, and some of the scarlets, are the best strawberries for a general crop, but the old pine has never been equalled for flavour.—*Magazine of Popular Science, No.* 4.

Potatoes.—In order to be as certain of obtaining as good a crop of potatoes as it is possible to be, *the ground, before being planted should be thoroughly pulverized; the manure should be well fermented; the sets should be whole potatoes, and never deprived of their first shoots, nor allowed to ferment; and, lastly, that a constant succession of new sorts should be raised from the berries of the old ones.*—*Quarterly Journal of Agriculture, No.* 31.

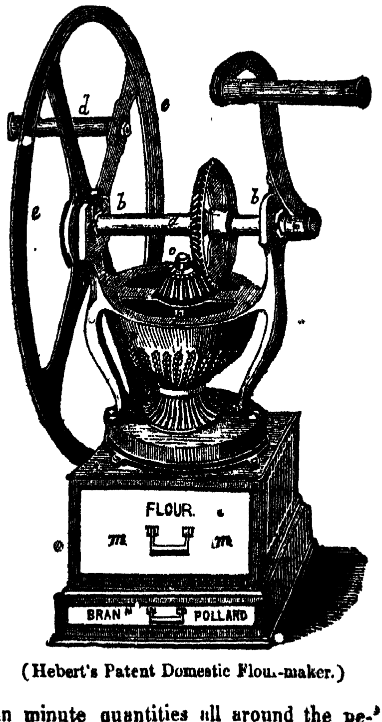
Method of grafting, or rather budding Vines. Communicated by Mr. George M'Leish, to the *Gardener's Magazine, No.* 73.—I took a small black Hamburgh vine, which had grown for a year or two in a pot, the stem of which did not exceed 4·10 of an inch in diameter, from which I excised two pieces of the extent of half their diameters. I then took two shoots from vines growing out of doors, from which I selected the buds (*a* and *b*); first cutting quite across the shoots, and afterwards slipping them longitudinally, reserving nearly all the pith to the part containing the bud; except the two extremities, which I cut away till the bark of the stock and scion came nicely in contact. I then bandaged them tightly together in the usual manner, only leaving the buds uncovered by the ligature. I next fitted a small flower-pot (size No. 60,) round the grafts, which I filled with the mould of an old cucumber bed: this was done about the beginning of November, and about a month afterwards the vine was plunged in a mild heat. The buds of the vine soon broke; and, in about three weeks afterwards, the buds from the scions were seen emerging from the mould in the pots. The bud *a* is now, (Jan. 21,) about 4 in. above the mould; and the other, as might be expected about half that distance.



(Grafting Vines.)

A newly recommended Remedy for destroying the Red Spider on plants is said to consist of syringing the plants with water in which common salt has been dissolved. A teaspoonful of salt to a gallon of water is as much as can be used with safety; and it will be well to wash the tree with pure water a day or two after the application of the salt.—*Gardener's Magazine, No.* 78.

Hebert's Patent Domestic Flour-maker.—By this simple machine, not only the grinding of the corn, but the *dressing* (sifting) of the meal into flour, pollard, bran, &c., are simultaneously performed. *a* is an axis, mounted in plummer blocks *bb*, and turned by a winch *c*, assisted, if required, by a handle *d*, fixed to one of the arms of the fly-wheel *e e*. The axis *a* also carries a bevelled wheel *f*, which drives a pinion *g*, fixed upon a vertical spindle *h*, that revolves in the centre of a metallic hopper *i*, and carries at its lower extremity the upper grinder; and to the periphery of the latter is attached a series of brushes, that revolve together with it inside the circular case *j*, cast in one piece with the hopper *i*. The lower grinder is fixed in the centre of the flat top *k* of the pedestal; and around the lower grinder, in the same plane as its superior surface, is an annulus of fine wire gauze; over the area of which the brushes sweep in their revolution, continually scattering every particle of the meal, as the

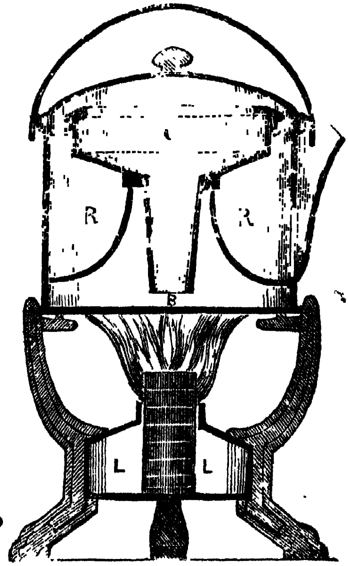


(Hebert's Patent Domestic Flour-maker.)

same is constantly projected in minute quantities all around the peripheries of the grinders, on to the wire-work; causing the flour to fall through the meshes into the drawer *m m* below: while the bran and pollard, which cannot pass the wire-gauze, are continually being freed from their adhering flour by the action of the brushes, until they are driven through an aperture, at the outer circumference of the wire-gauze, on to an inclined screen of coarse wire-work, where the offal separates itself, in the mere act of falling, into pollard and bran; both of which deposit themselves into separate compartments made in the drawer *n*. At *l* is a screw for regulating the admission of the corn; and at *o* is a lever, over an engraved plate, which directs the operator which way to move it, according as he may desire to regulate the grinding, whether coarser or finer than it was previously set. These adjustments are ob-

vious to the sight, and unerring in their action. A mill of this kind may be seen at No. 20, Paternoster Row. A larger machine upon this principle, is in use at the workhouse of All Saints, near Hertford, where it is worked by any number of men, from two to ten (by a suitable alteration of the feed), and is capable of properly grinding and dressing as much corn in a given time as other mills will grind only; the estimated power required to work it efficiently, being that of one horse, whether worked by that animal, or by wind, water, or steam.—*Mechanics' Mag.*, *No.* 665.

Patent Steam-fountain Coffee Pot.—Mr. Samuel Parker, the inventor, has completed this simple machine, the action of which is as follows:—Fill the boiler B with boiling water; fill the coffee box; C with ground coffee, spreading it level, without compressing it; then put on its perforated plate and cover, and place the box in its situation. L L, the spirit-lamp, being lighted, and the coffee-pot put over it, the water will shortly be seen to rise as a dark extract of coffee through the perforated plate of the cover of the box, and flow over into R R, the reservoir. The passage of the water should be allowed to continue until it becomes pale-coloured, and has, consequently, extracted the goodness of the coffee, when the lamp should be extinguished, and the lid put on. Every thing good in the seed will thus be extracted, without alloy from the unwholesome acid matter which is more or less mixed with all coffee made by the common methods. At the same time, nothing will be wasted in the process, which will be also expeditious. A clear and pure essence will be produced, small indeed in quantity at first, but of such strength that it may be diluted with milk or water. The lamp should be filled *only* two thirds with spirit. This Coffee Pot is made in tin, iron, copper, plated metal, and silver; and Mr. Parker constructs machines for chemical purposes on the same principle in copper and iron.



(Parker's Steam-fountain Coffee pot.)

MISCELLANIES.

LIST OF PATENTS SEALED IN 1835—6.

(*For.*) denotes communicated by a foreigner residing abroad.

Pumps.—J. Fussell, of Nunney, Somerset, edge tool-maker, for improvements in pumps.—Dec. 29, 1835.

Veneers.—J. Skinner, of Fen-court, London, civil engineer, for improvements in machinery for cutting wood for veneers.—Dec. 29.

Carding Cotton.—J. Hyde, of Ashton-under-Lyne, Lancaster, cotton manufacturer, for improvements in machinery for carding cotton.—Dec. 31.

Piano-fortes.—P. Erard, of Great Marlborough-street, musical instrument maker, for improvements on piano-fortes and other keyed musical instruments for seven years, being an extension of former letters patent granted to P. Erard by his late Majesty, King George IV.—Dec. 31.

Carriages.—J. Blyth, of Limehouse, engineer, for an improved method of retarding the progress of carriages.—Dec. 31.

Cleansing Feathers.—T. L. Wright, of Sloane-street, Chelsea, for improvements in machinery for cleansing, purifying, and preparing feathers and down, (*for.*)—Dec. 31.

Cotton Spinning.—J. Champion, of Salford, Lancaster, machine-maker, for improvements in machinery for spinning, twisting, and doubling cotton.—Jan. 6, 1836.

Cotton Spinning.—J. Ramsbottom, of Todmorden, Lancaster, mechanist, for improvements in machinery for roving, spinning, and doubling cotton.—Jan. 6.

Silk Manufacture.—W. Harter, of Manchester, silk manufacturer, for improvements in machinery for winding, cleaning, drawing, and doubling hard and soft silk.—Jan. 8.

Tanning.—F Brewin, Kent-road, Surrey, tanner, for improved processes of tanning.—Jan. 11.

Raising Earth.—I. T. Slade, of Fitzroy-square, for new or improved machinery for raising earth.—Jan. 11.

Sharpening Instruments.—J. W. Higham, of Tavistock-street, for an improved tablet for sharpening, razors, and other steel instruments.—Jan. 11.

Tentering Cloth.—J. B. Smith, of Salford, Lancaster, cotton-spinner; and J. Smith, of Halifax, York, dyer, for methods of tentering, stretching, or keeping out cloth to its width.—Jan. 14.

Jacquard Looms—M. Poole, of Lincoln's-inn, for improvements in jacquard looms, (*for.*)—Jan. 19.

Heating.—C. Brandt, of Upper Belgrave-place, mechanist, for improvements in heating, evaporating, and cooling fluids.—Jan 19.

Preserving Vegetable Substances.—F. Moll, of Grove-lane-terrace, Camberwell, for improvements in preserving vegetable substances from decay.—Jan. 19.

Propelling.—C. Harsleben, of Bold-street, Liverpool, for improvements in propelling vessels, carriages, and other vehicles.—Jan. 19.

Distillation.—R. Bowie, of Bishopsgate-street Within, surgeon, for improvements in distillation and decoction.—Jan. 21.

Power-Looms.—J. Ferrabee, of the Thrupp, Stroud, Gloucester, engineer, and R. Clyburn, of the same place, engineer, for improvements in power-looms.—Jan. 21.

Calico Printing.—W. Burch, Borough-road, Surrey, calico and silk printer, for improvements in machinery for printing silk and cotton, net or lace. —Jan. 23.

Diseases of the Lungs.—J. Jeffreys, of Osnaburgh-street, Regent's-park, for improvements in curing or relieving disorders of the lungs. —Jan 23.

Locomotive Engines.—H. Booth, of Liverpool, for improvements applicable to locomotive steam-engines and railway-carriages.—Jan. 23.

Propelling.—H. Pickworth, Sipson, Middlesex, for improvements in machinery for propelling vessels moved by steam or other power.—Jan. 26.

Rotary-Engine.—J. F. Kingston, of Islington, Devon, Esq., for a new rotary-engine.—Jan. 28

Carriage-Springs.—W. Boulnois, the younger, of Gower-street, Esq., for improved springs for carriages.—Jan. 30.

Hooks and Bows.—S. Reed, of Newcastle upon-Tyne, gentleman, for two improved hooks, and an improved bow for curves, baskets, buckets, and other vessels, which are conveyed, either loaded or empty, from one level to another.--Feb. 1.

Wool-Combing.—J. Baring, of Bishopsgate-street, merchant, for improvements in machinery for combing, or brushing, and separating wool, (*for.*)- Feb. 3.

Metal Tubes.—F. E. Harvey, of the Horsley Iron Works, Tipton, Stafford, mechanical draftsman, and J. Brown, also of Tipton, roll-turner, for improvements in manufacturing metallic tubes.—Feb. 3.

Cotton-Spinning.—E. Ashworth, of Egerton, Lancaster, cotton-spinner, and J. Greenough, of the same place, overlooker, for improvements in the machinery in spinning cotton, silk, and wool.—Feb. 5.

Loading and Unloading Ships.—H. Adcock, of Stamford-street, Blackfriars-road, civil engineer, for improvements in the loading and unloading of ships.—Feb. 5.

Paddles.—A. Massie, of St. John's, Wapping, engineer, R. Morton, of the same place, engineer, W. Ranwell, of Woolwich, coal-merchant, and E. Ranwell, of the same place, miller, for improvements in the construction of paddles.—Feb. 9.

Sweeping Streets.—F. H. Maberley, of Bourne, near Caxton, Cambridge, clerk, for improved machinery for scraping, and sweeping roads or streets.—Feb. 10.

Locks and Latches.—S. Fenton, of Fishguard, Pembroke, clerk, for improvements in locks and latches.—Feb. 10.

Dry Rot.—J. H. Kyan, of Ailsa-Park-Cottage, Twickenham, Esq., for a new mode of preserving certain vegetable substances from decay; to extend only to His Majesty's colonies and plantations.—Feb. 11.

Driving Machinery.—A. Smith, of Princes-street, St. Martin-in-the-Fields, engineer, for improvements in engines for driving machinery, and raising and lowering heavy bodies.—Feb. 12.

Steam Generator.—C. Schafhault, of Sheffield, gentleman, for an improved steam-generator.—Feb. 16.

Cutting Caoutchouc.—J. P. Westhead, of Manchester, small-ware manufacturer, for an improved method of cutting caoutchouc or India rubber, leather, &c.—Feb. 16.

Flax-Dressing—M. H. Simpson, of Ludgate-hill, merchant, for improvements in machinery for heckling, and preparing hemp, flax, and tow, (*for.*)—Feb. 17.

Piano-fortes.—J. Lidel, of Arundel-street, Panton-square, professor of music, for improvements in piano-fortes, (*for.*)—Feb. 17.

Propelling Vessels.—W. Bucknall, of Crutched Friars, cork merchant, for improvements in machinery for propelling vessels and for water-wheels.—Feb. 17.

Tanning.—F. Chaplin, of Bishop Stortford, tanner, for an improvement in tanning hides.—Feb. 18.

Lamps.—H. M. Robinson, of the Minories, paint and varnish manufacturer, for improvements in lamps.—Feb. 18.

Oxalic Acid.—J. Barsham, of Stepney Causeway, for improvements in the manufacture of oxalic acid and salacetonella.—Feb. 20.

Ships' Cooking Apparatus.—F. Peyre, junior, of St. Etienne, France, dyer, at the White Hart Inn, Southwark, for improvements in ships' cooking apparatus, and for obtaining distilled-water from sea-water, (*for.*)—Feb. 23.

Weaving.—C. G. Gilroy, of Argyle-street, St. Pancras, engineer, for improvements in machinery for weaving.—Feb. 25.

Dyeing.—W. G. Scarth, and R. Scarth, both of Leeds, York, dyers, for manufacturing blue dyes from materials not hitherto used for that purpose.—Feb. 25.

Bedsteads.—J. Barron, Brass Founder, and E. Thomas, workman to J. Barron, both of Birmingham, Warwick, for improvements on beadsteads.—Feb. 25.

Caoutchouc.—R. W. Sievier, of Henrietta-street, Cavendish-square, Middlesex, gentleman, for an improvement in the means of dissolving and preparing caoutchouc, or India-rubber.—Feb. 27.

Caoutchouc.—J. Martin, of Charing-cross, Westminster, gentleman, for an improvement in dissolving and preparing caoutchouc or India-rubber, (*for.*)—Feb. 27.

Hosiery.—W. Bates, of Leicester, fuller and dresser, for improvements in finishing hosiery and other goods manufactured from lamb's wool, angola, and worsted yarn.—March 8.

Rotary Action.—C. Schafhault, of Sheffield, York, gentleman, for improved gear for obtaining a continuous rotary action.—March 8.

Plating.—A. T. Merry, of Birmingham, Warwick, metal dealer, for the application of certain white metal plated to manufactures of which it has not hitherto been applied.—March 8.

Jacquard Machine.—J. Morrison, of Paisley, North Britain, manufacturer, for an improvement on the jacquard machine, and on what is called the tens box lay, and in the reading and stamping machines used in making shawls and figured work.—March 8.

Caoutchouc.—J. G. Hartley, of Devonshire-street, Bishopsgate-street Without, for improvements in preparing or manufacturing caoutchouc or India-rubber.—March 8.

Piano-fortes.—J. Godwin, of Cumberland-street, Hackney-road, Mid-

dlesex, piano-forte maker, for an improvement in the construction of piano-fortes.—March 8.

Chemical Apparatus.—B. Simmons, of Winchester-street, Southwark, engineer, for improvements in retort mills and other chemical apparatus. —March 8.

Gases.—G. H. Palmer, of the Canal-grove, Old Kent-road, civil engineer, for an improvement in the purification of inflammable gases.—March 8.

Piano-fortes.—C. Guynemer, of Manchester-street, Manchester-square, Middlesex. professor of singing, for improvements in piano-fortes, (*for.*) —March 8.

Screw-Stoppers.—G. Lawrence, of No. 9, New Bond-street, Middlesex, dressing-case maker, for an improvement in the screws used in fastening the mouths of mounted ink stands, &c.—March 8.

Steam-Engines.—J. Diggle, of Bury, Lancaster, engineer, for improvements in steam-engines.—March 8.

Tallow Melting.—C. Watt, of Clapham, Surrey, gentleman, for improvements in preparing, purifying, and refining tallow stuff.—March 8.

Essence of Anchovies.—J. Masters, of Leicester, for an improved essence of anchovies.—March 14.

Vices.—J. Chalklen, and T. Bonham, of Oxford-street, Middlesex, water-closet manufacturers, for improvements in vices.—March 14.

Steam-Engines.—E. Jelowicki, of No. 8, Seymour-place, Byanstone-square, Middlesex, Esq., for improvements in steam-engines.—March 14.

Bobbin Net.—T. Alcock, of Claimes, Worcester, lace manufacturer, for improvements in machinery for making bobbin net lace.—March 17.

Ear Instruments.—A. W. Webster, of Regent-street, Middlesex, Aurist, for an instrument to be applied to the ear, to assist in hearing.—March 17.

Needle-making.—J. Birkby, Upper Rawfolds, Liversedge, near Leeds, York, card maker, for improvements in machinery in making needles.—March 17.

Preserving.—L. E. Seignette, of Mincing-lane, London, merchant, for improvements in preserving animal and vegetable substances, (*for.*)—March 17.

Propelling Vessels.—W. Hancock, of Stratford, Essex, engineer, for improved mechanical means of propelling vessels through water.—March 17.

Hydrometers and Saccharometers.—R. B. Bate, of No. 21, Poultry, London, optician, for improvements upon hydrometers and saccharometers, for the term of seven years, being an extension of former letters patent for this invention.—March 21.

Stamping Metals.—F. G. Spilsbury, of Newman-street, Oxford-street, engineer, for improvements on machinery for stamping up and compressing metals.—March 22.

Chloride of Lime.—W. Maugham, of Newport-street, Lambeth, Surrey, chemist, for improvements in the production of chloride of lime, &c. —March 22.

Propelling.—W. Hale, of Greenwich, Kent, civil engineer, for improvements in machinery for vessels propelled by steam or other power. —March 22.

Fire Arms.—W. W. Richards, of Birmingham, gun maker, for improvements in primers for discharging fire arms by means of percussion. —March 22.

Soap Manufacture.– J. Cox, of Bristol, soap manufacturer, for improvements in the manufacture of soap.—March 22.

Propelling.—Sir J. S Lillie, of St. John's, Fulham, Middlesex, for an improved mode of acquiring power for the purpose of propelling carriages, barges, &c.—March 23.

Belts, Bands, and Straps.—J. L. Hood, of Newcastle-upon-Tyne, gentleman, and A. Smith, of Princes-street, Leicester-square, Middlesex, engineer, for improved belts, bands, and straps, to be employed in place of ropes or chains.—March 26.

Milking Cows.—W. Blurton, of Field-hall, near Uttoxeter, Stafford, gentleman, for an apparatus for extracting milk from cows.—March 26.

White Lead.—W. Gossage, of Stoke Prior, Worcester, chemist, and E. W. Benson, of Wichbold, in the same county, chemist, for improvements in manufacturing ceruse or white lead.—March 29.

Wool-combing.—J. Noble, the elder, of Mill-place, Commercial-road, wool-comber, for improvements in the combing of wool.—March 29.

Spinning.—C. de Bergne, of Clapham-rise, Surrey, engineer, for improvements in machinery for spinning and doubling yarn or thread manufactured from cotton.—March 29.

Japanned Ware.—W. Brindley, of Caroline-street, Birmingham, paper-maker, for improvements in the manufacture of tea-trays and other japanned ware.—March 29.

Hats.—T. C. Hogan, of Castle-street, Holborn, hat-manufacturer, for improvements in hats, caps, and bonnets.—March 29.

Power-looms.—A. Parkinson, of Low Moor, Lancaster, for an improved stretcher, to be used in hand or power-looms, (*for.*)—March 29.

Drawing.—S. Parlour, of Addiscombe-road, Croydon, Surrey, gentleman, for improvements in sketching or drawing.—March 31.

Umbrellas.—J. J. Rubery, of Birmingham, umbrella and parasol furniture manufacturer, for improvements in umbrella and parasol stretchers.—April 7.

Mining.—J. Spurgin, of Guildford-street, Russel-square, M.D., for a new or improved ladder for working mines.—April 7.

Steam Boilers.—J. Holmes, of Birmingham, Warwick, engineer, for improvements in the construction of boilers for steam-engines.—April 7.

Bleaching.—T. R. Bridson, of Great Bolton, Lancaster, bleacher, for improvements in bleaching linen.—April 7.

Power Machine.—R. Copland, of Brunswick-crescent, Camberwell, Esq., for improvements upon patents already obtained by him for combinations of apparatus for gaining power.—April 9.

Music Register.—M. Berry, of Chancery-lane, civil engineer, for new or improved mechanism for marking down or registering the notes played on the keys of piano-fortes, (*for.*)—April 7.

Steam-engines.—J. Perkins, of Fleet-street, engineer, for improvements in steam-engines, and in generating steam and evaporating and boiling fluids.—April 12.

Soap.—J. Leman, of Lincoln's-inn-fields, gentleman, for improvements in making soap, (*for.*)—April 12.

Chemicals.—T. H. Leighton, of Blyth, Northumberland, chemist, for improvements in the converting sulphate of soda into the subcarbonate of soda or mineral alkali.—April 12.

Cleaning Wool.—J. Bates, of Bishopsgate-street, merchant, for improvements in machinery for cleaning and preparing wool, (*for.*)—April 16.

Block Printing.—J. Parkinson, of Rose Bank, Bury, Lancaster, calico-printer, for improvements in the art of block printing.—April 19.

Bobbin Net.—J. Pedder, of Radford, Nottingham, lace-maker, for improvements in machinery for making figured or ornamented bobbin net lace.—April 21.

Lace.—H. W. Nunn, of Newport, Isle of Wight, lace-manufacturer, for improvements in manufacturing embroidered lace.—April 21.

Power Machine.—H. Stansfield, of Leeds, merchant, for machinery for generating power, (*for.*)—April 23.

Time-keepers.—E. J. Dent, of the Strand, chronometer-maker, for an improvement of the balance-springs, and their adjustments of chronometers and other time-keepers.—April 23.

Water-closets.—J. Findon, of Black-horse-yard, Holborn, coach-smith, for improvements in apparatus for supplying water to water-closets.—April 23.

Railways.—G. A. Kollman, organist of his Majesty's German Chapel, St. James's Palace, for improvements in railways and in locomotive carriages.—April 23.

Locomotive Carriages.—E. J. Massey, of Liverpool, watch-maker, for improvements in railway and other locomotive carriages.—April 23.

Pens.—S. Mordan, of Castle-street, Finsbury-square, mechanist, for an improvement in making triple-pointed pens.—April 23.

Steam Power.—W. Taylor, of Smethwich, Stafford, engineer, and H. Davies, of Stoke Prior, Worcester, engineer, for improvements in machinery for introducing water into steam boilers or evaporating vessels; also for obtaining mechanical power by the aid of steam, and for communicating motion to vessels floating in water.—April 26.

Cotton Spinning.—T. Aitken, of Edenfield, Bury, spinner, for improvements in the preparation of cotton, and in the conveyance of the same to roving-frames, mules, throstles, &c.—April 26.

Calico Printing.—W. Preston, of Sunnyside, Lancaster, operative calico printer, for improvements in printing calico.—April 28.

Cotton Spinning.—J. B. Smith, of Talford, Lancaster, cotton-spinner, for improvements in the machinery for roving, spinning, and twisting cotton.—April 30.

Farinaceous Food.—J. Whiting, of Rodney-buildings, New Kent-road, M. D., for improvements in preparing farinaceous food.—May 3.

Roads.—J. Macneill, of Parliament-street, civil engineer, for improvements in turnpike or common roads.—May 3.

Sawing.—H. Sharpe, of Broad-street-buildings, London, merchant, for improvements in sawing wood and other materials, (*for.*)—May 3.

Bobbin Net.—W. Sneath, of Ison-green, Nottingham, lace-maker, for improvements in machinery by which thread-work ornaments can be formed in bobbin net, net, or lace.—May 3.

Door-springs.—W. A. Howell, of Ramsgate, Kent, smith, for improvements in the construction of springs for doors.—May 3.

Iron Tubes.—T. H. Russell, of Took's-court, London, tube-maker, for improvements in manufacturing welded iron tubes.—May 3.

Refining Sugar.—E. Pontifex, of Shoe-lane, London, coppersmith, for an improvement in making and refining sugar, (*for.*)—May 5.

Watches.—J. Banister, of Colchester, Essex, watch-maker, for improvements in watches and other time-keepers.—May 7.

Steam-engines.—J. Elvey, of Canterbury, millwright, for improvements in steam-engines.—May 7.

Weaving.—M. Hawthornthwaite, of Kendal, Westmoreland, weaver, for a new mode of producing patterns in woven goods.—May 7.

Saddles.—T. Taylor, of Banbury, Oxford, saddler and harness-maker, for improvements in saddles for riding.—May 7.

Horse-collars.—L. Hebert, of No. 20, Paternoster-row, London, for improvements in horse-collars, (*for.*)—May 9.

Raising Water.—J. Hague, of Cable-street, Wellclose-square, engineer, for an invention for raising water from mines, holds of ships or vessels, &c.—May 9.

Railway Carriages.—R. Waddington and J. Hardman, of Bradford, iron-founders, for an improved method of constructing wheels for railway carriages.—May 10.

Bobbin Net.—R. Birkin, of Basford, Nottingham, lace-manufacturer, for improvements in machinery for making bobbin net lace.—May 11.

Fire-places.—R. Wilson, of Blyth Sheds, Northumberland, builder, for improvements in manufacturing fire-places, slabs, columns, &c., hitherto made of marble.—May 12.

Passing Boats.—T. Grahame, of Nantes, France, but now of Suffolk-street, Pall-mall, gentleman, for improvements in passing boats from one level to another.—May 13.

Carriage Wheels.— —— Ashdowne, of Tunbridge, Kent, gentleman, for improvements in apparatus to be added to wheels of carriages.—May 13.

Piano-fortes.—W. Kirk, of Commercial-street, Leeds, manufacturer of piano-fortes, for improvements in piano-fortes.—May 14.

Spinning.—J. Whitworth, of Manchester, engineer, for improvements in machinery for spinning and doubling cotton, wool, &c.—May 17.

Steam-engines.—D. Fisher, of Wolverhampton, mechanic, for an improvement in steam-engines.—May 17.

Locomotive Apparatus.—H. W. Wood, of No. 29, Austin-friars, London, merchant, for improvements in certain locomotive apparatus.—May 17.

Paper-making.—J. Brown, of Esk-mills, Pennycuick, North Britain, paper-maker, for improvements in machinery or apparatus for making paper.—May 18.

Power Machine.—T. Beck, of Little Stoneham, Suffolk, gentleman, for new or improved apparatus for obtaining power and motion, to be used as a mechanical agent generally.—May 18.

Railways.—P. B. G. Debac, of Brixton, Surrey, civil engineer, for improvements in railways.—May 18.

Rotary Steam-engine.—H. Elkington, of Birmingham, Warwick, gentleman, for an improved rotary steam-engine.—May 23.

Hat-making.—W. Watson, of Leeds, dyer, for an improvement in dyeing hats.—May 24.

Filtration.—J. M. Gerothwahl, of Camberwell-grove, Surrey, merchant, for improvements in filtration, (*for.*)—May 28.

Propelling.—F. P. Smith, of Hendon, farmer, for an improved propeller for steam and other vessels.—May 31.

Evaporating.—W. Gossage, of Stoke Prior, Worcester, chemist, for improvements in the apparatus for evaporating water from saline solutions, and in the construction of stoves for drying salts.—June 2.

Bread-making.—L. Hebert, of Paternoster-row, for improved machinery for the manufacture of bread.—June 2.

Capstans.—Baron H. de Bode, of Edgware-road, for improvements in capstans.—June 4.

Carriages.— M. Bower, of Birmingham, Warwick, manufacturer, for improvements in carriages.—June 7.

Hinges.—J. Young, of Wolverhampton, Stafford, for improvements in metal hinges.—June 7.

Pumps.—D. Chambers, of Carey-street, Lincoln's-inn, water-closet-manufacturer, and J. Hall, of Margaret-street, Cavendish-square, plumber, for an improvement in pumps.—June 7.

Drying Wheat.—M. Berry, of Chancery-lane, Holborn, mechanical draughtsman, for improvements in machinery for cleaning and drying wheat, (*for.*)—June 7.

Surgical Instruments.—A. G. Hull, of Cockspur-street, Charing-cross, Esq., for improvements in instruments for supplying the prolapsed uterus.—June 9.

Nautical Apparatus.—E. Massey, of King-street, Clerkenwell, watch-maker, for improvements in the apparatus for measuring the progress of vessels through the water, and for taking soundings at sea.—June 13.

Cooking Apparatus.—J. Perkins. of Fleet-street, civil engineer, for improvements in apparatus for cooking.—June 13.

Baking Apparatus.—M. Berry, of Chancery-lane, civil engineer, for improved apparatus for roasting vegetable substances, (*for.*)—June 13.

Dressing Cloths.—A. Ritchie, of Leeds, York, merchant, for improvements in dressing and finishing woollen cloths, (*for.*)—June 13.

Puddling Iron—C. Schafhault, of Dudley, Worcester, gentleman, for improved apparatus for puddling iron.—June 13.

Revolving Harrow.—T. Vaux, of Woodford-bridge, Essex, land-surveyor, for constructing and applying a revolving harrow.—June 13.

Rotary Steam-engines.—J. White, of Southampton, engineer, for improvements in rotary steam-engines.—June 15.

Suspension Chains.—J. Dredge, of Walcot, Bath, brewer, for improvements in suspension chains for bridges, viaducts, &c.—June 17.

Steam Boilers.—J. Hopkins, of Exmouth-street, Clerkenwell, surveyor, for improvements in furnaces for steam-engine boilers.—June 18.

Machinery.—L. Gachet, of Cambridge-heath, Middlesex, g for improvements in machinery for manufacturing metals.—June 18.

Window-shutters.—J. Bunnett, of Newington Causeway, Southwark, window-blind-maker, for improvements in window-shutters.—June 18.

Beetroot Sugar.—W. Watson, of Liverpool, merchant, for improvements in the manufacturing of sugars from beet-root, (*for.*)- June 18.

Window-sash Pulleys.—J. Young, of Wolverhampton, for improvements in manufacturing boxes and pulleys for window-sashes.—June 21.

Boilers.—R. Smith, of Manchester, engineer, for improvements in metallic plates for boilers.—June 22.

Cotton-twisting Machinery.—W. Wright, of Salford, machine-maker, for improvements in twisting machinery for cotton, &c.—June 22.

Block Printing—C. P. Chapman, of Cornhill, London, zinc manufacturer, for improvements in printing silks.—June 22.

Gas-lighting.—W. Barnett, of Brighton, founder, for improvements in generating and purifying gas for illumination.—June 22.

Weaving.—H. Stansfeld, of Leeds, merchant, for improvements in

machinery for preparing certain threads, and for weaving, (*for.*)—June 22

Carbonate of Baryta.—J. Woolrich, of Birmingham, chemist, for improvements in producing carbonate of baryta.—June 22.

Lace.—H. Dunington, of Nottingham, lace-manufacturer, for improvements in making lace.—June 22.

Metal Gilding.—G. R. Elkington, of Birmingham, gilt toy-maker, for an improved method for gilding metals.—June 24.

Sawing Timber.—J. M'Dowall, of Johnstone, Renfrew, and of Manchester, engineer, for improvements in machinery for sawing timber.—June 24.

Propelling.—S. Hall, of Basford, Nottingham, for improvements in propelling vessels and in steam-engines.—June 24.

File-machinery.—A. Stocker, of Birmingham, for improvements in machinery for making files.—June 25.

Block Printing.—J. Roberts, of Prestolle, Lancaster, calico-printer, for improvements in block-printing.—June 27.

Calico Printing.—B. Woodcroft, of Ardwick, Lancaster, for an improved mode of printing colours on calico.—July 2.

Printing.—W. W. Potts, W. Maclune, and W. Bourn, all china manufacturers, of Burslem, Stafford, for an improved method of transferring impressions or patterns to metal, wood, cloth, papier machee, bone, slate, marble, &c.—July 2.

Anchors.—S. Meggitt, of Kingston-upon-Hull, master mariner, for improvements in anchors, and in apparatus for fishing.—July 2.

Plate Glass.—R. W. Swinburne, of South Shields, agent, for improvements in plate glass.—July 4.

Iron and Steel.—J. I. Hawkins, of Pancras Vale, Hampstead-road, engineer, for an improvement in manufacturing iron and steel, (*for.*)—July 4.

Nail-making.—W. S. Stocker, of Birmingham, mechanist, for improvements in machinery for making of nails.—July 7.

Propelling.—M. Heath, of Furnival's-inn, Esq., for new mechanical combinations for propelling vessels, &c., (*for.*)—July 11.

Steam Boilers.—E. H. Collier, of City-road, formerly of Boston, in the State of Massachusetts, U.S., civil engineer, for improvements in steam-boilers.—July 13.

Stave-machinery.—M. Berry, of Chancery-lane, Holborn, mechanical draftsman, for improvements in apparatus, for forming staves for barrels, (*for.*)—July 13.

Carriages.—L. M. Horlinc, Haymarket, gentleman, for improvements in carriages and harness, (*for.*)—July 13.

Dressing Cloths.—O. Bird, of Woodchester, Gloucester, clothier, and W. Lewis, of Brunscomb, Stroud, Gloucester, clothier, for improvements in machinery for dressing of woollen and other cloths.—July 13.

Propelling.—J. Ericsson, of Brook-street, New-road, civil engineer, for an improved propeller applicable to steam navigation.—July 13.

Rotary Machine.—W. Essex, of Cheetham, near Manchester, Lancaster, agent, for improvements in machinery for producing rotary motion.—July 13.

Gas.—S. Brewer, of Boswell-court, Cary-street, engineer, for improvements for generating gas.—July 14.

Drawing off Liquors.—C. Phillips, of Chipping Norton, Oxon, surgeon, for improvements in drawing off beer from casks or vessels.—July 14.

File-machine.—J. Ericsson, of Brook-street, New-road, civil engineer, for improved machinery for manufacturing files.—July 20

Musical Instruments.—C. Wheatstone, of Conduit-street, and J. Green, of Soho-square, musical instrument manufacturers, for a new method of forming musical instruments.—July 27.

Lace Nets.—J. Hall, of New Radford, Nottingham, lace manufacturer, for improvements in machinery for dressing lace-nets.—July 27.

Chemicals.—P. Spence, of Henry-street, Commercial-road, chemist, for improvements in the manufacture of Prussian blue, prussiate of potash, and plaster of Paris.—July 27.

Evaporating.—C. Brandt, of Belgrave-place, Pimlico, gentleman, for an improved method of evaporating and cooling fluids.—July 27.

Stocking-making.—N. Baily, of Leicester, frame-smith, for improvements in machinery for manufacturing stocking fabric.—Aug. 1.

Brandy.—J. T. Betts, of Smithfield Bars, London, rectifier, for improvements in preparing brandy, (*for.*)—Aug. 3.

Preserving Timber.—W. Flockton, of the Spa-road, Bermondsey, turpentine distiller, for improvements in preserving timber.—Aug. 3.

Carding Wool.—J. Archibald, of Alva, Stirling, Scotland, manufacturer, for improvements in machinery for carding wool.—Aug. 4.

Carriages.—R. R. Reinagle, of Albany-street, Regent's-park, Esq., for improvements in carriages.—Aug. 6.

Railways and Steam-engines.—T. Binns, of Mornington-place, Hampstead-road, civil engineer, for improvements in railways and steam-engines.—Aug. 6.

Heat Screen.—T. J. Fuller, of Limehouse, civil engineer, for an improved screen for intercepting the radiant heat from the boilers and cylinders of steam-engines.—Aug. 9.

Tentering Cloth.—J. B. Smith, of Salford, Lancaster, spinner, and J. Smith, of Halifax, dyer, for tentering cloth.—Aug. 10.

Pit Chains.—H. P. Parkes, of Dudley, Worcester, iron-merchant, for improvements in flat pit chains.—Aug. 11.

Oakum.—J. Douglass, of Morpeth, Northumberland, rope-maker, for improvements in the manufacture of oakum.—Aug. 11.

Propelling.—E. Light, of Royal-street, Lambeth, civil engineer, for improvements in propelling vessels.—Aug. 11.

Instantaneous Light.—W. Newton, of Chancery-lane, for improvements in producing instantaneous ignition, (*for.*)—Aug. 11.

Axletrees.—R. A. Hurlock, of Whaddon, Cambridge, clerk, for improvements in axletrees.—Aug. 11.

Steam.—J. B. Bacon, of Regent's-square, gentleman, for improvements in apparatus for generating steam.—Aug. 13.

Wash Machinery.—T. Gauntley, of Nottingham, mechanic, for improvements in machinery for making lace, commonly called wash machinery.—Aug. 15.

Window-sashes and Shutters.—G. Leech, of 25, Norfolk-street, Islington, carpenter, for an improved method of connecting window-sashes and shutters.—Aug. 15.

Springs.—W. F. Cooke, of Bellayse College, Durham, Esq., for improvements in winding up springs to produce continuous motion.—Aug. 17.

Salt Manufacture.—J. Hall, of Margaret-street, Cavendish-square, plumber, for improvements in the manufacture of salt.—Aug. 17.

Propelling Vessels.—F. de Tansch, of Percy-street, Bedford-square, for improvements in apparatus for propelling vessels.—Aug. 25.

Polishing.—R. Griffiths, machine-maker, and J. Gold, glass-cutter, both of Birmingham, for improvements in machinery for grinding and polishing plate-glass, window-glass, marble, slate, and stone.—Sept. 1.

Caoutchouc.—J. Pickersgill, of Coleman-street, merchant, for improvements in preparing and in applying India-rubber or caoutchouc to, fabrics, (*for.*)—Sept. 1.

Mechanical Power.—J. Surrey, of York House, Battersea, miller, for a new application of a principle by which mechanical powermay be obtained or applied.—Sept. 1.

Building under Water.—W. Bush, of Wormwood-street, Bishopsgate Within, surveyor and engineer, for improvements in the apparatus for building and working under water.—Sept. 3.

Mashing.—C. Farina, of Clarendon-place, Maida Vale, Middlesex, gentleman, for an improved mashing-apparatus.—Sept. 15.

Tanning.—W. H Cox, of Bidminster, near Bristol, tanner, for improvements in tanning hides and skins.—Sept. 15.

Candle-making.—J. F. W. Hempel, of Oranienburg, Prussia, but now of Clapham, Surrey, Officer of Engineers, and H. Blundell, of Hull, Yorkshire, colour-manufacturer, for an improved method of manufacturing candles from vegetable and animal substances —Sept. 15.

Hinges.—J. Bates, of Bishopsgate-street, London, merchant, for improved apparatus for making metal hinges.—Sept. 15.

New Acid.—P. A. Tealdi, formerly of Mendovi, in Piedmont, but now residing in Manchester, Lancashire, merchant, for a new extract, or vegetable acid, (*for.*)—Sept. 15.

Cotton Reels.—W. Bates, of Leicester, fuller and dresser, for improvements in the manufacture of reels for reeling cotton.—Sept. 16.

Cabs.—M. Poole, of Lincoln's Inn, Middlesex, gentleman, for improvements in the vehicles called cabs, (*for.*)—Sept. 21.

Book-Shelves.—R. Jupe, of Bond-street, Middlesex, cabinet-maker, for improvements in apparatus applicable to book and other shelves.—Sept. 22.

Bobbin Net.—W. Crofts, of Radford, Nottinghamshire, machine-maker, for improvements in machinery for bobbin net lace.—Sept. 22.

Locomotive Engines.—H. Van Wart, gentleman, and S. A. Goddard, both of Birmingham, Warwickshire, for improvements in locomotive steam-engines and carriages.—Sept. 22.

Dressing.—J. Smith, of Halifax, Yorkshire, dyer, for improvements in machinery for dressing worsted fabrics.—Sept. 22

Anchors.—M. Poole, of Lincoln's Inn, gentleman, for improvements in anchors and in friction-rollers, (*for.*)—Sept. 15.

Capstans.—W. P. Green, of Falmouth, Cornwall, lieutenant, R.N., for improvements on capstans, applicable to ships and mines.—Sept. 28.

Blast-furnaces.—J. I. Hawkins, of Hampstead-road, Middlesex, civil engineer, for an improvement in the blowing-pipe of blast-furnaces and forges.—Sept. 28.

Iron Manufacture.—G. Crane, of Yuiseedywyn Iron Works, near Swansea, iron-master, for an improvement in the manufacture of iron.—Sept. 28.

Sulphate of Soda.—W. N. Clay, of West Bromwich, Stafford, chemist, for improvements in the manufacture of sulphate of soda.—Sept. 28.

Carriage Drags.—R. Pearson, of St. Giles, Oxford, for improvements in drags for retarding carriages.—Sept. 28.

Woollen Cloths.—J. L. Phillips, of Melksham, Wiltshire, cloth-manufacturer, for an improvement in the manufacture of woollen cloths.—Oct. 4.

Railways.—J. White, of Lambeth, engineer, for improvements on railways.—Oct. 4.

Weaving Harness.—C. W. Stone, of Finchley, Middlesex, mechanic, for improvements in harness for weaving purposes, (*for.*)—Oct. 4

Fuel.—H. H. Mohun, of Walworth, Surrey, M.D., for improvements in the manufacturing of fuel.—Oct. 4.

Tanning.—S. T. Jones, of Manchester, merchant, for improvements in the tanning of hides and skins.—Oct. 6.

Screws.—M. Berry, of 66, Chancery-lane, Holborn, mechanical draftsman, for improvements in machinery for manufacturing metal screws.—Oct. 6.

Spinning.—J. Sharp, of Dundee, Forfar, flax-spinner, for machinery for converting ropes into tow, and improvements in machinery for preparing hemp or flax for spinning.—Oct. 8.

Hats, Caps, &c.—H. Scott, junior, and R. S. Oliver, hatters, of Edinburgh, for improvements in the manufacture of hats, caps, and bonnets, (*for.*)—Oct. 13.

Roller-blinds.—F. B. Geithner, of Birmingham, brass-founder, for improvements in drawing or winding up window and other roller-blinds or maps.—Oct. 13.

White Lead.—J. Hemming, of Edward-street, Portman-square, Middlesex, gentleman, for improvements in the manufacture of white lead.—Oct. 13.

Decomposition of Salt.—T. Lutwyche, of Liverpool, Lancaster, manufacturing chemist, for improvements in apparatus used in the decomposition of common salt.—Oct. 13.

Railways.—J. Ruthven, of Edinburgh, for improvements in the formation of rails or rods for railways and in fixing them.—Oct. 13.

Steam-boilers.—C. P. Devaux, of Fenchurch-street, London, merchant, for a new or improved apparatus for preventing the explosion of steam, (*for.*)—Oct. 13.

Fermentation.—J. J. C. Sheridan, of Peckham, Surrey, chemist, for improvements in the saccharine, vinous, and acetous fermentation.—Oct. 20.

Wheel Carriages.—W. B. Adams, of Camden-town, Middlesex, coachmaker, for improvements in wheel carriages.—Oct. 20.

Caoutchouc.—C. Nickels, of Guildford-street, Lambeth, manufacturer of caoutchouc, for improvements in preparing and manufacturing caoutchouc.—Oct. 24.

Hat Bodies.—J. Crook, of Liverpool, merchant, for improvements in the machinery for manufacturing hat bodies, (*for.*)—Oct. 28.

Gas-lighting.—T. Edge, of Great Peter-street, Westminster, gas-apparatus manufacturer, for improvements in lighting by gas, oil, or spirit-lights or lamps, (*for.*)—Oct. 28.

Power Machinery.—R. Copland, of Courlands, Wandsworth-road, Surrey, Esq., for improvements upon patents already obtained by him for apparatus for gaining power.—Nov. 5.

Railways.—J. E. Smith, of Liverpool, merchant, for improvements in railways and on locomotive-carriages, (*for.*)—Nov. 8.

Carriage Drags.—J. Whitcher, of Ringwood, Hants, carrier, for improvements in Drags for carriages.—Nov. 8.

Bobbin Net.—J. Smith, the younger, and F. Smith, both of Radford, Nottingham, mechanics, for improvements in machinery for making bobbin-net, or twist-lace.—Nov. 8.

Cotton Spinning.—J. Linsey, of Bury, Lancaster, cotton-spinner, for improvements in machinery for spinning cotton, &c.—Nov. 10.

Meters.—B. Paterson, of Peacock-street, Newington, Surrey, engineer, for improvements in meters or apparatus for measuring gas or liquids.—Nov. 12.

Hats.—H. A. Wells, of New York, but now residing in Threadneedle-street, London, for improvements in the manufacture of hats.—Nov. 15.

Substitute for Bees-wax.—F. Woolley, of Commercial-road, Middlesex, gentleman, for improvements in the manufacture of a substitute for bees-wax.—Nov. 15.

Rotary-engines.—J. Yule, of Sanchiehall-street, Glasgow, practical engineer, for improvements in rotary engines.—Nov. 15.

Calico Printing.—A. Applegath, of Crayford, Kent, calico-printer, for improvements in printing calico.—Nov. 15.

Cotton Spinning.—J. Whitworth, of Manchester, engineer, for improvements in machinery for spinning cotton, &c.—Nov. 19.

Combs.—W. Norris, of Alston, Cumberland, land-surveyor, for improvements in the manufacture of combs, (*for*)—Nov. 19.

Silk Manufacture.—J. G. Campbell, merchant, and J. Gibson, throwster, both of Glasgow, for a new or improved manufacture of silk.—Nov. 19.

Dyeing.—J. Buchanan, of Ramsbottom, Lancaster, millwright, for an improved apparatus for dyeing.—Nov. 22.

Signal Lights.—T. Robson, of Dalston, Middlesex, operative chemist, for improvements in firing signal and other lights.—Nov. 22.

Sugar Manufacture.—G. Guynne, of Holborn, gentleman, and J. Young, Brewer, of Brick-lane, for improvements in the manufacture of sugars.—Nov. 22.

Alarm-gun.—I. Naylor, of Stainbrough, near Barnsley, York, gamekeeper, for an alarm gun or reporter and detector.—Nov. 22.

Steam-engines.—T. Hackworth, of New Shildon, near Bishop Auckland, engineer, for improvements in steam-engines.—Nov. 22.

Metal Manufacture.—T. Ellis, of Stamford-hill, Middlesex, Esq., and T. Burr, of Shrewsbury, Shropshire, for improvements in the manufacture of sheets, pipes or tubes of lead, and other metal.—Nov. 24.

Power Machine.—J. Woollams, of Wells, Somerset, gentleman, for improved means of obtaining power and motion from known sources.—Nov. 24.

Embroidery.—W. Sneath, of Ison-green, Nottingham, lace-maker, for improvements in embroidery on muslins, silks, &c.—Nov. 28.

Rivets.—A. Stocker, of Bardesley Iron-works, and H. Downing, of French Walls Iron-works, both of Birmingham, gentlemen, for improvements in manufacturing rivets, screw-blanks, &c.—Nov. 29.

Propelling.—D. N. Carvelho, of Fleet-street, London, bookseller, for improvements in propelling vessels on water and carriages on land, (*for.*)—Dec. 3.

Water-pressure Engine.—R. Armstrong, of Stonehouse, Devon, M.D., for improvements in the water-pressure engine.—Dec. 3.

Power Machine.—M. Poole, of Lincoln's-inn, Middlesex, gentleman, for machinery for generating power, (*for.*)—Dec. 3.

Harps.—J. Corbett, of Richmond-place, Limerick, Ireland, professor of music, for improvements on the harp.—Dec. 3.

Steam engines.—J. Perkins, of Fleet-street, London, engineer, for improvements in steam-engines, furnaces, and boilers.—Dec. 3.

Measuring Fluids.—G. Sullivan, of Morley's Hotel, Charing-cross, Middlesex, gentleman, for improvements in machinery for measuring fluids, (*for*)—Dec. 3.

Railway Tunnels.—H. Booth, of Liverpool, Lancaster, Esq., for improvements in railway tunnels, to be worked by locomotive engines.—Dec. 3.

Drying Grain.—T. Don, of James-street, Golden-square, Middlesex, gentleman, for improvements in drying grain, seeds, &c.—Dec. 3.

Blacking.—W. Bryant and E. James, of Plymouth, Devon, merchants and co-partners, for improvements in liquid and paste blacking.—Dec. 3.

Book-binding.—W. Hancock, of Windsor-place, City-road, Middlesex, gentleman, for improvements in book-binding.—Dec. 7.

Raising Water.—H. Adcock, of Mount Pleasant, Liverpool, Lancaster, civil engineer, for improvements in the raising of water from mines.—Dec. 9.

Fibrous Substances.—F. B. Zincke, the younger, of Crawford-street, Marylebone, Esq., for manufacturing of the leaf of a certain plant into a fibrous substance not hitherto used in manufactures.—Dec. 9.

Portmanteaus.—S. Pratt, of Peckham-rye, Surrey, gentleman, for improvements in the construction of portmanteaus, &c.—Dec. 9.

Bleaching.—L. W. Wright, of Manchester, Lancaster, engineer, for improvements in machinery for bleaching linens, cottons, &c.—Dec. 9.

Railways.—J. Yates, of Limehouse, Middlesex, for improvements in train-roads or railways, and in the wheels or other parts of carriages.—Dec. 9.

Draining-tiles.—G., Marquis of Tweeddale, for an improved method of making tiles for draining, soles, house-tiles, flat-roofing tiles, and bricks.—Dec 9.

Locomotive Steam-engines.—J. Melling, of Liverpool, Lancaster, engineer, for improvements in locomotive steam-engines.—Dec. 15.

Power Machine.—R. T. Beck, of Little Stonham, Suffolk, gentleman, for new or improved apparatus for obtaining power and motion, (*for.*)—Dec. 15.

Cotton.—W. Sharpe, of North Britain, merchant, for improvements in the treatment of cotton-wool, (*for.*)—Dec. 15.

Plate-glass.—R. W. Swinburne, of South Shields, Durham, agent, for improvements in the manufacture of plate-glass.—Dec. 15.

Chairs.—J. T. Hester, of Abingdon, Berks, surgeon, for an improvement in the constructing of chairs.—Dec. 15.

Cabriolets and Omnibuses.—T. Routledge and E. Galloway, of Water-lane, London, gentlemen, for improvements in cabriolets and omnibuses.—Dec. 19.

Locomotive Engines.—T. E. Harrison, of Whitburn, Durham, engineer, for improvements in locomotive engines.—Dec. 21.

Ships' Rigging.—A. Smith, of Princes-street, Westminster, engineer, for improvements in standing rigging and stays for ships.—Dec. 21.

Carding.—J. Crighton, of Manchester, for improvements in cylinders in carding-engines.—Dec. 21.

Spinning.—J. Potter, of Manchester, cotton-spinner, for improvements in spinning machinery.—Dec. 21.

Chemistry.—J. Swindells, of Manchester, manufacturing chemist, for improvements in the decomposition of muriate of soda.—Dec. 21.

Lamps.—G. Houghton, of High Holborn, Middlesex, glass-merchant, for improvements in lamps, (*for.*)—Dec. 21.

Cabriolets.—S. Gillet, of Guildford-street, gentleman, and J. Chapman, of Paddington, mechanist, for improvements in cabriolets.—Dec. 21.

Chemistry.—W. Gossage, of Stoke Prior, Worcester, chemist, for improved apparatus for decomposing common salt.—Dec. 24.

Calico Printing.—B. Woodcroft, late of Ardwick, Manchester, but now of Mumps, Oldham, gentleman, for an improved mode of printing calico.—Dec. 24.

Pulleys.—H. Stansfeld, of Leeds, York, merchant, for a tappet and lever action to produce a vertical or horizontal movement in pulleys, (*for.*)—Dec. 30.

SCIENTIFIC BOOKS PUBLISHED IN 1836.

ABBATT's Treatise on the Calculus of Variations.—Ainger's (Alf.) Building Act, with Notes and Cases.—Allen's (John) Treatise on Arithmetic.—Annual Dahlia Register for 1836.—Barlow's (P.) Treatise on Manufactures, &c. of Great Britain.—Bateman's Library for the Chemist and Druggist, &c.—Belcher's Whitby and Pickering Railway. —Book of Shells.—The Botanist's Manual.—Bridgewater Treatise; Buckland on Geology, &c., 2 vols.—British Annual, and Epitome of Science.—British Association, Fifth Report, (Dublin).—British Cyclopædia of the Arts and Sciences, 2 vols.—Burmeister's Manual of Entomology, by Shuckard.—Burr's Introduction to the Study of Geology.—Burt's Observations on the Curiosities of Nature.—Cambridge Mathematical Problems and Examples, 1821—36.—Camus on the Teeth of Wheels, trans. by Hawkins.—Chambers' Educational Course (Chemistry)—Ditto (Plane Geometry).—Clarkson's (Thos.) Antediluvian, &c., Researches.—Cooper's Flora Metropolitana.—De Quincy on Imitation of the Fine Arts, trans. by Kent.—Doyle's Practical Gardening—Flower and Fruit Garden.—Dunn's (Rt.) Ornithologist's Guide, (Orkney, &c.)—Everest's Popular View of Homœopathy.—Fairbairn on the Political Economy of Railroads.—Gaskell on Artisans and Machinery.—Glossary of Terms used in Architecture.—Goring and Pritchard's Essays on Microscopes, &c.—Gould's Birds of Europe, parts 1 to 19—Ditto of the Himalaya Mountains—Gould's Monograph of the Ramphastidæ, Toucans,)—Ditto Trogonidæ, (Trocans,) part 1 and 2.—Granville on the Royal Society of the 19th Century.—Hamilton's (G. E.) Designs for Churches.—Hart's (John) Treatise on Oblique Arches.—Hooker's Figures, &c. of New and Rare Plants, part I.—British Flora, vol. 2, part

Metaphysic of Ethics, trans. by Semple.—King's (T.) Designs for Carving and Gilding.—Lecount's Examination of Barlow's Reports on Iron Rails, &c.—Levesque's Art of Brewing and Malting.—Library of Useful Knowledge: Mathematics, vols. 1 and 2.—Linnington's Scientific Reader.—Lugar's Plans, &c. of Ornamental Domestic Buildings.—Mac-

gillivray's Rapacious Birds of Great Britain.—Magazine of Popular Science, vol. 1.—Memoirs of the Royal Astronomical Society, vols. 8 and 9.—Metaphysic Rambles, part 3.—Mudie's Popular Mathematics—Astronomy for Schools, &c.—Murphy's Meteorology in connexion with Astronomy.—Noble's Professional Practice of Architects.—Pasley's Theory of Natural Philosophy.—Phillips' Geology of Yorkshire, part 2.—Philosophical Transactions, 1836, part 1.—Rennie's Alphabet of the Sciences, 4 vols.—Richardson's (Wm.) Catalogue of 7,385 Stars, (S. Hemisphere.)—Ritchie's Differential and Integral Calculus.—Ross's (Capt.) Appendix to his Second Voyage.—Simpson's (Step.) View of Homœopathy.—Smeaton's Reports on Civil Engineering.—Smith's (J. E.) English Flora, vol. 5, part 2—Botany, by Macgillivray.—Taylor's (Rd.) Scientific Memoirs, parts 1 and 2.—Transactions of the Cambridge Philosophical Society, vol. 6, part 1—Geological Society, vol. 4, part 2—Horticultural Society, vol. 2, parts 1 and 2—Institute of British Architects, part 1—Institution of Civil Engineers—Linnæan Society, vol. 17, part 3—Zoological Society, vol. 2, part 1.—Proceedings of the Zoological Society, part 3, for 1835—Treatise on Perspective.—Ure on Cotton Manufacture of Great Britain, &c., 2 vols.—Walker's (T. D.) Properties of the Dinsdale Sulphur Spring.—Webster's (Thos.) Theory of Equilibrium, and Motion of Fluids.—Wood's (N.) Ornithologist's Text Book.—Wood's (C. T.) Ornithologist's Guide.—Yarrell's History of British Fishes, 2 vols.—Young's Geological Survey of the Yorkshire Coast.

Practical Facts in Chemistry; being a Companion to Ede's Portable Laboratories.

OBITUARY OF PERSONS EMINENT IN SCIENCE AND ART, 1836.

Antoine Laurent de Jussieu, F.R.S., a name singularly illustrious in the annals of Botanical Science; and nephew to the great Bernard de Jussieu, whom he succeeded as Administrator of the Garden of Plants, at Paris, in 1779. In the year 1789, he published his great and truly classical work, entitled *Genera Plantarum secundum Ordines naturales deposita*, which caused a total revolution in the science of Botany. To the modification and extension of the views contained in this work, he devoted the remainder of his life. His later Memoirs, many of which are of great value, are chiefly contained in the *Annales*, and subsequently in the *Memoirs des Museum d'Histoire Naturelle*.

Dr. Richard Pearson, fellow of most of the learned societies in London, and co-editor with Drs. Hutton and Shaw of the Abridgement of the *Philosophical Transactions*.

Mons. Ampere, F.R.S., Professor of the Polytechnic School at Paris, author of Memoirs on the Mathematical Theories of Electro-magnetic Currents, &c.

Baron de Ferussac, founder and editor of the *Bulletin Universel*.

Lieutenant Murphy, of the Royal Engineers, who was Astronomer to the Euphrates Expedition, and was a man of high scientific attainments.

Sir John Soane, Professor of Architecture in the Royal Academy, F.R.S., &c. Among his most important works are the Bank of England, the National Debt Redemption Office, the Privy Council Office, the Law

Courts at Westminster, parts of the House of Lords, the State Paper Office, the new appendages to Chelsea Hospital, Churches at Walworth and Marylebone. In the year 1833, he presented to the nation his costly Architectural Museum, in Lincoln's-inn-fields, which will shortly be openep to the public, as the Soanean Museum.

Dr. William Henry, F.R.S., to whom the science of Chemistry generally, and of Gaseous Chemistry in particular, is under great obligations. He was the author of several papers in the *Philosophical Transactions*, and in the *Memoirs of the Manchester Society*; and of one of the best written and best arranged Systems of Chemistry. Than Dr. Henry few persons have contributed more effectually, by their discoveries and exertions, to the promotion of those arts and manufactures which form the foundation of the prosperity of a great commercial nation.

Carl Wichmann, Sculptor.

Abraham Saportas, President of the Royal Institution, Amsterdam.

W. Y. Ottley, author of the *Italian School of Design*, &c.

Malaise, Sculptor, Brussels.

M. K. F. Erbstein, Dresden, Antiquities and Numismatics.

Dr. Christian Ludwig Stieglitz, Archæology, &c.

Dr. F. K. Ludwig Sickler, Archæology, &c.

Benjamin Wyatt, Architect of Drury-lane Theatre, &c.

Richard Westall, R.A.

Bodenmuller, Sculptor.

Matthew Kessels, Dutch Sculptor.

P. Velyn, Artist, Amsterdam.

Abbate Carlo Fea, celebrated Archæologist, Rome.

I. F. Schroter, Anatomical draftsman.

M. Persoon, the learned Botanist, author of *Synopsis Plantarum*, &c.

C. M. Fischer, Curator of the Botanic Garden of Gottingen.

M. Deleuze, Honorary Librarian of the Garden of Plants, at Paris; translator of Darwin's *Loves of the Plants*, &c.

Thomas Burton, Esq., author of the *Midland Flora*.

Galloway Bey, twelve years Chief Engineer to the Pacha of Egypt.

Mr. Pond, F.R.S., Astronomer Royal, having succeeded Dr. Maskelyne in the year 1810.

Sir Charles Wilkins, F.R.S., the first Englishman who thoroughly mastered the difficulties of the Sanscrit language.

Captain James Horsburgh, F.R.S., Hydrographer to the East India Company; author of the *East India Sailing Directory*, "one of the most valuable contributions that was ever made by the labours of one man to the interests of navigation."

The Rev. William Lax, F.R.S., Lowndes's Professor of Astronomy and Geometry in the University of Cambridge, and author of Tables to be used with the *Nautical Almanac*.

Sir John Sinclair, Bart., F.R.S., author of the *Statistical Account of Scotland*, and many works in useful science.

Sir William Gell, F.R.S., the Topographical Antiquary.

Dr. William Elford Leach, F.R.S., to whom we are chiefly indebted for the first introduction into this country of the natural system of arrangement in Conchology and Entomology, and for the adoption of those more general and philosophical views which originated with Latreille and Cuvier. Dr. Leach was the author of several papers in the *Linnæan Transactions*, and elsewhere.

MEETINGS OF THE LITERARY AND SCIENTIFIC INSTITUTIONS OF LONDON FOR 1836—37.

Societies.	Times of Meeting.	November.	December.	January.	February.	March.	April.	May.	June.
Royal Society -	Thur. 8½ P. M.	17, 24, 30	8, 15, 22	12, 19, 26	2, 9, 16, 23	2, 9, 16	6, 13, 20, 27	4, 11, 25	1, 8, 15
Society of Antiq.	Thur. 8 P. M.	17, 24	1, 8, 15, 22	12, 19, 26	2, 9, 16, 23	2, 9, 16	6, 13, 2[illegible], 24	[illegible], 11, 25	1, 8, 15
Linnæan Society	Tues. 8 P. M.	1, 15	6, 20	17	7, 21	7, 21	4, 18	[illegible] 24	6, 20
Horticul. Soc.	Tues. 3 P. M. Nov. Dec. Jan. & Feb. 2 P. M.	1	6	17	7, 21	7, 21	4, 18	2, 16	6, 20
Royal Med. and Chirurg. Soc.	Tues. 8½ P. M.	8, 22	13, 27	10, 24	14, 28	14, 28	11, 25	9, 23	..
Institution of Civil Enginr.	Tues. 8 P. M.	..	..	10, 17, 24, 31	7, 14, 21, 28	7, 14, 21, 28	4, 11, 18, 25	2, 9, 16, 23, 30	..
Zoological Soc.	Tues. 8½ P. M.	8, 22	13, 27	10, 24	14, 28	14, 28	11, 25	9, 23	13, 27
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Society of Arts	Wed. 7½ P. M.	2, 9, 16, 23	7, 14, 21	11, 18, 25	1, 8, 15, 22, 29	1, 8, 15, 22, 29	5, 12, 19, 26	3, 10, 17, 24, 31	7, 14
Society of Arts	Tues. 8 P. M.	8	13	10	14	14	11	9	13
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Graphic	Wed. 8 P. M.	..	..	11	8	8	12	10	14
Royal Soc. of Lit.	Thur. 4 P. M.	10, 24	8, 22	12, 26	9, 23	9, 23	13, 27	11, 25	8, 22
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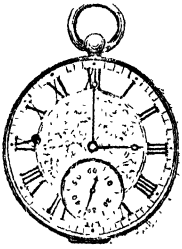

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